PACIFIC NW REGION
DOUGLAS-FIR TUSSOCK MOTH
Final Environmental Impact Statement

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Douglas-fir Tussock Moth
in the Pacific Northwest Region

ABSTRACT: The USDA Forest Service, Pacific Northwest Region, proposes to implement a management strategy that would partially control an anticipated outbreak of Douglas fir tussock moth, *Orgvia pseudotsugata* ("DFTM"). This strategy would be implemented on nine National Forests in Washington and Oregon: the Colville, Okanogan, Wenatchee, Umatilla, Wallowa-Whitman, Malheur, Ochoco, Winema, and Fremont. The anticipated outbreak could affect 700,000 acres or more of National Forest lands and could result in partial or complete defoliation of Douglas-fir and true fir trees.

The goal of this project is to maintain vegetative conditions of forested areas of concern that are at risk from defoliation from Douglas-fir tussock moth. These areas include aquatic and terrestrial species habitat, areas for human use and enjoyment, and administrative areas. Project objectives are:

- Protect habitat for threatened and endangered species, specifically salmon, steelhead, bull trout, wildlife nesting habitat, designated old growth, and late and old structural stands
- Protect health and safety areas, including residential and administrative areas, high use developed recreation areas, municipal watersheds, and designated scenic areas.
- Protect high investment areas, such as seed orchards and areas currently being protected from bark beetles.

Significant issues were also identified during public scoping in September and October 1999. They are:

1) Human health effects from contact with the larvae, and from spraying.
2) Protection of timber values.
3) Possible effects on non-target Lepidoptera (moths and butterflies).
4) Forest Health.

This document analyzes three action alternatives and a "no action " alternative. The Proposed Action would protect Areas of Concern from defoliation by Douglas-fir tussock moth. It would protect these areas by spraying *Bacillus thuringiensis*, var. *kurstaki* (B.t.k.), a naturally occurring bacteria, or TM-BioControl, a naturally occurring virus. The Expanded Protection Alternative would protect all areas identified in the Proposed Action plus all areas with 60-100% host type trees, excluding Wilderness. B.t.k. and TM-BioControl would be used. The TM-BioControl Only Alternative would protect the same areas as the Proposed Action, but with the TM-BioControl insecticide only. There would be no protection with implementation of the No Action Alternative. In the No Action Alternative and on all unprotected land in the other three alternatives, the tussock moth would be allowed to follow its natural course of population build up and decline on all affected National Forests.

EXECUTIVE SUMMARY

INTRODUCTION

This environmental impact statement discusses the direct, indirect, and cumulative impacts to the environment that could result from efforts to control an anticipated outbreak of Douglas-fir tussock moth, *Orgyia pseudotsugata*, on portions of nine National forests in Oregon and Washington: the Colville, Okanogan, and Wenatchee in Washington; and the Umatilla, Wallowa-Whitman, Malheur, Ochoco, Fremont, and Winema in Oregon.

The Douglas-fir tussock moth is a native insect that feeds on needles of its host trees, Douglas-fir, true fir and white fir. They are always present in the environment. Populations of this insect periodically reach outbreak levels and can cause significant damage in some areas when it does. The outbreaks arise suddenly and last for only 2-4 years, but can cause significant defoliation. According to data from the early warning trapping system, populations have been increasing. This trend appears to be more widespread than previous, more localized outbreaks. It is anticipated that a widespread Douglas-fir tussock moth outbreak will occur in the next 5 years.

PURPOSE AND NEED

The GOAL is to maintain existing vegetation conditions and protect specific resources that are at risk from Douglas-fir tussock moth defoliation for the short-term until long-term management actions restore natural forest conditions over the landscape.

The NEED exits to protect specific areas of concern where the tussock moth defoliation would change or jeopardize vegetative conditions for resources such as Threatened and Endangered species habitat, health and safety areas, and areas where the Forest Service has made substantial investment.

This EIS is being prepared in advance of an anticipated Douglas-fir tussock moth outbreak; it is not known exactly where the outbreak will occur, but when an outbreak occurs, it will happen very suddenly. We have identified and are analyzing effects on all acres that could *potentially* be affected by Douglas-fir tussock moth defoliation and subsequent tree mortality. It is certain that the outbreak will only occur on parts of the acres in any of the alternatives. Although many acres are being analyzed, if an action alternative is selected, it would only occur on areas with increasing Douglas-fir tussock moth populations. Many of the areas in this analysis will, in fact, never experience outbreak populations.

Acres analyzed under this EIS are all acres with the host type (Douglas-fir, true fir and white fir). The number of acres analyzed varies with each alternative.

Objectives

- Protect riparian habitat where defoliation would cause unacceptable degradation of occupied habitat, especially critical spawning or rearing habitat for salmon, steelhead, and bull trout (loss of shade, increased sedimentation, etc.).
- Protect nesting, roosting, and foraging habitat for Spotted Owls where defoliation would reduce total crown closure so that an area could no longer function as a reproductive/fledgling site.
- Protect areas within designated Northwest Forest Plan Late Successional Reserves ("LSRs") where habitat needs to be maintained until the overall quality of that habitat improves.
- Protect designated old growth and late/old structure ("OG/LOS") stands where defoliation would substantially degrade habitat values.
- Protect residential and administrative sites where defoliation and the presence of large numbers of larvae would adversely affect people living or working there. This would include work centers, special use permit summer home sites, resorts, or established camps. Protect high use recreation sites where defoliation and the presence of large numbers of larvae would adversely affect many forest visitors. This would include campgrounds, picnic areas, and interpretive sites.
- Protect municipal watersheds where an existing formal agreement is in place and where 100% defoliation would have unacceptable impacts on water quantity or quality.
- Protect designated foreground scenic areas of concern where defoliation would have a substantial adverse impact on scenery.
- Protect seed orchards and plantations of genetically superior trees where defoliation would result in a considerable loss of investment and a reduction of seed needed for future seedling demand.
- Protect areas where investments have already been made to protect Douglas-fir or other firs from bark beetles.

Two biological insecticides have been identified for use, if control of Douglas-fir tussock moth populations is warranted. These are *Bacillus thuringiensis* var. *kurstaki* (B.t.k.) and TM-BioControl. They would be applied primarily as an aerial application, although some ground application could also occur. B.t.k. is a bacterium that occurs naturally in the soil. It is specific to Lepidoptera (moths and butterflies). It must be eaten by the caterpillar

stage of these insects in order to be effective. Effects on species varies. TM-BioControl is an insecticide that is made of the natural virus of the tussock moth. This virus occurs naturally and is the primary cause of the collapse of Douglas-fir tussock moth outbreaks under natural conditions. This virus is specific only to Douglas-fir tussock moth and three other species of tussock moths.

PUBLIC SCOPING AND COMMENT:

A Notice of Intent for this EIS was published in the *Federal Register* in June 18, 1999. Public Scoping and comments were received until August 20, 1999. Issues were identified and alternatives were developed based on the public comments. The Draft Environmental Impact Statement was issued in January with public comments received until Feb 29. 2000.

ISSUES

Issues were identified by an Interdisciplinary Team (IDT) of Forest Service resource specialists, based on input received during the public scoping process. Significant Issues had the greatest influence during the development of alternatives. Both the Significant and Other Issues are used in the decision-making process.

1. Human Health Effects: There are many areas of human use not included in the Proposed Action, such as dispersed recreation areas, less used campsites, fishing spots, and general forest areas. Human health could be affected through direct contact with larvae. In addition, there was the concern of possible effects on human health from the spraying.
2. Protection of Timber Values: Areas not included in the Proposed Action that contain commercially viable timber need to be protected to prevent mortality and loss of timber value.
3. Non-Target Lepidoptera: B.t.k. could kill larvae of non-target Lepidoptera.
4. Maintaining Healthy Forests: a) Allow the natural cycle of tussock moth to thin out Douglas-fir and true fir trees, thus restoring a "healthy ecosystem"; b) Protect forests from tussock moth because dead or dying trees are a sign of an "unhealthy forest".
5. Fuel Build-up and Fire Risk: In unprotected areas, additional fuels could increase the risk of ignition and catastrophic fire.
6. Effects of Spraying on Fish and Wildlife: Wildlife or fish could ingest insecticide.
7. Water Quality: a) Defoliation of unprotected riparian areas could affect stream temperature, peak flows, sediment input, etc.: b) The insecticide could pollute streams and lakes.
8. Economic Effects from Decreased Tourism: Protection of recreation areas could help local communities by maintaining tourist and recreation income.
9. Tussock moth larvae could increase the food supply for wildlife species: Killing tussock moth larvae could reduce the opportunity for certain wildlife to take advantage of a food surplus.
10. Operations: Spraying could cause environmental problems or limit access to the forest during operations. Examples include fuel spills, helicopter crashes, noise, and road closures during operations.
11. Secondary Mortality: Weakened trees that survive the tussock moth infestation could die from secondary attacks by bark beetles or other forest pathogens.

ALTERNATIVES CONSIDERED IN DETAIL

Four alternatives were considered in this analysis:

No Action Alternative – This alternative would allow the Douglas-fir tussock moth outbreak to occur naturally. All acres with 20% or more host type were analyzed under this alternative.

Proposed Action – This is essentially the Proposed Action that was described during Public Scoping. In this alternative, specific areas of concern, as identified by the above objectives, would be protected from defoliation. A total of 628,000 acres were analyzed under this alternative. The areas of concern vary in size and location throughout the Forests, and range from a total of 190 acres analyzed on the Fremont NF to 130,000 acres analyzed on the Umatilla NF. Table 1, below identifies the number of acres analyzed for the areas protected under the proposed action.

Expanded Protection Alternative – This alternative was developed as a result of Public Scoping. Primary public concerns that influenced the development of this alternative were the need to maintain a healthy forest, protection of timber values, and protection of dispersed recreation sites. The acres in this analysis include the acres for the areas of concern in the Proposed Action, and in addition, all acres with 60% or more host type. A total of 2,505,220 acres are analyzed under this alternative. Table 2, page vi, shows the acres analyzed in the Expanded Protection Alternative.

TM-BioControl Only Alternative – This alternative was developed in response to the public comments from the Draft Environmental Impact Statement. It analyzes the same acres that are in the Proposed Action, but considers only using TM-BioControl. There is some risk with this alternative because there is a limited supply of TM-BioControl available.

COMPARISON OF ALTERNATIVES

Please see Ch. II, Comparison of Alternative, Table II-3, for a complete review of all alternatives.

Table 1: Areas Protected under the Proposed Action and TM-BioControl Alternative, in acres

FOREST→	COL	OKA	WEN	UMA	W-W	MAL	OCH	WIN	FRE[1]	TOTAL
Bark Beetle Protection	0	0	3,260	0	800	3,600	0	0	0	7,660
Fish – Anadromous	0	0	1,230 (18 miles)	27,610 (179 mi.)	6,490 (92 miles)	2,170 (31 mi.)	7,190 (102 mi.)	0	0	44,690 422 mi.
Fish - Bull Trout	0	270 (4 mi.)	340 (5 mi.)	23,380 (98 mi.)	6,010 (85 mi.)	2,700 (39 mi.)	0	0	190 (3 mi.)	32,890 (234 mi)
Late Succ. Reserves (LSRs)	0	16,600	74,800	0	0	0	0	0	0	91,400
Nesting Hab. Spotted Owl	0	3,000	32,000	0	0	0	0	1,600	0	36,600
Nesting Habitat Bald Eagle	0	0	0	50	0	0	0	0	0	50
Old Growth	0	0	0	18,570	17,660	14,950	55,450	23,100	0	129,730
Late & Old Structure				17,200	83,440	28,860	64,680			194,180
Recreation: high use areas	7,100	1,940	110	3,230	10,940	140	4,200	20	0	27,680
Residential & Admin.	0	120	8,650	940	0	60	240	150	0	10,160
Scenic	0	98,130	4,840	67,270	0	33,630	7,650	0	0	211,520
Seed Orchards	150 (5 Orchards)	420 (2 Orch.)	0	180 (3 Orch.)	360 (6 Orch.)	0	0	0	0	935
Municipal Watershed	0	0	0	12,280	8,740	150	540	0	0	21,710
Other	0	0	610	20	0	14,860	0	1,510	0	17,000
Total[2]	7,260	122,070	93,330	130,310	110,520	72,910	66,680	24,610	190	627,880

[1] Includes the Demming Creek watershed only.
[2] The columns do not necessarily add up to the "Total" acres since there is some overlap among Area of Concern categories.

Table 2: Areas Protected under the Expanded Action Alternative, in acres

FOREST→	COL	OKA	WEN	UMA	W-W	MAL	OCH	WIN	FRE	TOTAL
Areas of Concern protected in Proposed Action & TM-BioControl Alt.	7,260	122,070	93,330	130,310	110,520	72,910	66,680	24,610	190	627,880
Additional Acres Protected this Alt.	551,190	261,690	31,570	349,530	368,550	260,980	6,570	46,590	660	1,877,330
Total, this Alt.	558,450	383,760	124,900	479,840	479,070	333,890	73,260	71,200	850	2,505,220
Total Acres of 20-60% Host Type Not Protected	621,560	493,170	176,620	931,870	959,700	706,070	112,700	237,350	3,710	4,242,750

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Chapter I: PURPOSE OF and NEED FOR ACTION

SUMMARY OF CHANGES BETWEEN DRAFT AND FINAL

A more detailed description of the biological control agents, B.t.k. and TM-BioControl, was added or relocated from various Appendices and Chapters.

Objectives and Issues were clarified and identified earlier in the Chapter.

The Proposed Action was clarified.

Removed most Wilderness areas from the Proposed Action.

Removed project objectives concerning eagle nesting habitat and previously awarded timber sale areas.

Clarified that protection would not occur in Natural Research Areas.

There is no “preferred” alternative in this Final EIS.

INTRODUCTION

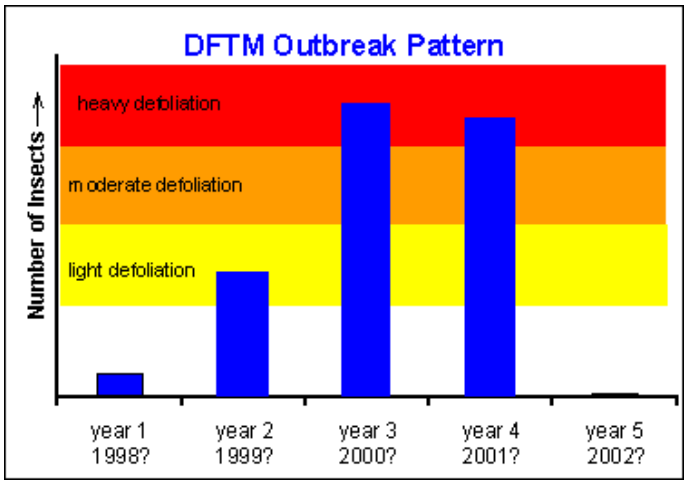
This environmental impact statement discusses the direct, indirect, and cumulative impacts to the environment that could result from efforts to control an anticipated outbreak of Douglas-fir tussock moth, *Orgyia pseudotsugata*, on portions of nine National Forests in Oregon and Washington.

The Douglas-fir tussock moth ("DFTM") is a tree defoliator – in the larval stage, it lives by eating needles of live trees. It attacks Douglas-fir (*Psuedotsuga menziesii*) and "true" firs: grand fir (*Abies grandis)*, subalpine fir (*Abies lasiocarpa)*, and white fir *(Abies concolor).* Tussock moth populations are cyclic, with an epidemic every 7-13 years. Each outbreak lasts 2-4 years and ends with a sudden crash. The outbreaks usually occur in mature and over-mature multi-story stands with a high density of host trees. Trees on ridge tops and south facing slopes are the most vulnerable because of the stress from a generally drier location.

Tussock moths are always present in the environment. Since the female moth is incapable of flight, tussock moth outbreaks generally arise in place, with little or no spread into uninfested or previously treated areas. If an outbreak occurs, it is because DFTM populations are already on site, and conditions are favorable. Populations too low to be detected one year can erupt into destructive populations the next. Once populations explode, substantial damage can occur before land managers are able to implement management options. Because of an outbreak in the early 1970s, the United States Department of Agriculture initiated a program to research the moth. The objective was to better anticipate future outbreaks and to develop management options. One result of this program was a survey technique, the "Douglas-fir Tussock Moth Early Warning System", to monitor population trends. Tussock moth traps (photo, left) are placed in forests throughout eastern Washington and Oregon. The number of captured male moths helps gauge the overall moth population. During a non-outbreak year, it is common to have very few or no moths in most traps. Ground sampling is initiated when average capture exceeds 40 moths/trap.

Photo I-1: Moth Trap

In the Pacific Northwest, a tussock moth population increase consists of four phases (see Outbreak Pattern graph). During the first phase, the population begins to build but remains below outbreak levels. In phase II (shown as year 2), populations increase to outbreak levels and light defoliation becomes apparent. By phase III (year 3), populations are extremely high and there is widespread tree defoliation. During phase IV (year 4), viral infection, competition, predation, and parasitism cause the population to collapse. Thereafter, predators and parasites maintain the DFTM populations at low levels during non-outbreak years (shown as year 5). Affected trees may continue to die for several years following defoliation due to secondary effects of bark beetles or other insects.



In the past, tussock moth outbreaks were treated by spraying insecticide after significant defoliation became evident. Specialists now know that for treatment to be effective, it must occur from mid-June to mid-July (when larvae are actively feeding) and before heavy defoliation becomes apparent (i.e. early in phase III). Since 1974, populations have fluctuated twice without reaching outbreak levels except for a few places in eastern Oregon. A 1991 outbreak was treated with *Bacillus thuringiensis kurstaki*, commonly known as B.t.k.

According to data from the "early warning" system, DFTM populations have been increasing. This trend appears to be more widespread than the previous localized outbreaks. Within the next few years, outbreaks could occur on nine Pacific Northwest National Forests: the Colville, Fremont, Malheur, Ochoco, Okanogan, Umatilla, Wallowa-Whitman, Wenatchee, and Winema. The analysis in this document covers only National Forest lands. The anticipated outbreak is expected to occur primarily in the years 2000-2002 and could last through 2004. Defoliation could be similar to the 1971-1974 outbreak. In many places, DFTM would act as a natural disturbance agent by reducing overstocking and creating stand openings. The "early warning" merely provides an opportunity to evaluate potential impacts on specific areas (riparian areas, campgrounds, etc.) where foliage protection might be critical. It also allows the Forest Service to evaluate possible effects of short-term management strategies on specific sites.

SCOPE OF THIS DOCUMENT

This environmental impact statement examines several alternatives that the Forest Service could use to manage a tussock moth outbreak in Oregon and Washington. The document only provides guidance for situations in which the Forest Service would actively protect National Forest lands. The actual tussock moth outbreak would probably

occur on other federal, state, and private lands. This EIS does not attempt to analyze impacts on those lands, however, information in this document may be useful to other land managers when planning actions that are a consequence of the outbreak. Actions of other landowners to manage tussock moth on their own lands are not constrained by this document. Typically, state forestry programs help private landowners deal with forest pest problems. The Forest Service remains available to cooperate with these landowners whenever possible.

The options discussed in this analysis represent short term management strategies to maintain existing vegetation conditions in specific areas and to protect specific resources until long term management actions restore natural forest conditions over the landscape. It is not the intent of this EIS to attempt to stop or prevent the overall tussock moth outbreak, or to prevent defoliation over the entire area where the outbreak may occur.

PURPOSE AND NEED

Based on the "early warning" monitoring system, an outbreak of Douglas-fir tussock moth is anticipated in the next several years. The tussock moth typically defoliates trees in patches, sometimes over large areas, which can result in significant tree mortality. If this outbreak is as intense as anticipated, it could be similar to an outbreak in the early 1970s when approximately 700,000 acres were defoliated in Oregon, Washington, and Idaho. This outbreak saw approximately 17,270 acres of total mortality in patches, and 75 % tree mortality over 62,070 acres, and 10 % tree mortality over 275,660 acres (USDA Forest Service, 1974).

Goal: To maintain existing desired vegetative conditions in Areas of Concern that are at risk from Douglas-fir tussock moth defoliation within the next two to five years. These areas include but are not limited to aquatic and terrestrial species habitat, areas for human use and enjoyment, and administrative areas.

Need: The need exists to protect specific Areas of Concern where tussock moth defoliation would change or jeopardize vegetative conditions in Threatened and Endangered (T & E) species habitat, health, and safety areas, and areas where the Forest Service has made substantial investments (such as a seed orchard). Preserving this vegetation would maintain desired habitats for fish and wildlife, preserve campgrounds, and maintain important scenic viewsheds. Additionally, there is a concern for public health. The hairs on the larvae can cause welts, rashes, and other allergic reactions in some people.

Though the alternatives specify acres that would be protected if an outbreak occurred in those areas, this does not mean that blanket spraying would occur. ***Spraying would only occur where tussock moths increased to sub-outbreak or outbreak population levels in areas identified in the selected alternative within the next five years as specified in the alternative selected.***

Objectives:

- Protect riparian habitat where defoliation would cause unacceptable degradation of occupied habitat, especially critical spawning or rearing habitat for salmon, steelhead, and bull trout (loss of shade, increased sedimentation, etc.). The criterion to measure the effects of each alternative and to compare alternatives is the number of miles of stream protected from defoliation within host type where defoliation results in unacceptable degradation of occupied habitat especially important spawning and rearing habitat.
- Protect nesting, roosting, and foraging habitat for Spotted Owls where defoliation would reduce total crown closure so that an area could no longer function as a reproductive/fledgling site. The criteria to measure the effects of each alternative and to compare alternatives are the number of Spotted Owl activity centers protected within host type where defoliation results in unacceptable degradation of nesting, roosting, and foraging habitat.
- Protect areas within designated Northwest Forest Plan Late Successional Reserves ("LSRs") where habitat needs to be maintained until the overall quality of that habitat improves. The criterion to measure the effects of each alternative and to compare alternatives is the number of acres of LSR protected where the defoliation of LSR results in unacceptable loss of late successional habitat within the LSR.
- Protect designated old growth and late/old structure ("OG/LOS") stands where defoliation would substantially degrade habitat values. The criterion to measure the effects of each alternative and to compare alternatives is the number of acres of old growth / LOS protected where the defoliation of these stands results in unacceptable degradation of their habitat values.
- Protect residential and administrative sites where defoliation and the presence of large numbers of larvae would adversely affect people living or working there. This would include work centers, special use permit summer home sites, resorts, or established camps. The criterion to measure the effects of each alternative and to compare alternatives is the number of sites protected where the presence of the larvae would adversely affect people where they live or work, or would cause unacceptable degradation of the environment in the area.
- Protect high use recreation sites where defoliation and the presence of large numbers of larvae would adversely affect many forest visitors. This would include campgrounds, picnic areas, and interpretive sites. The criterion to measure the effects of each alternative and to compare alternatives is the number of sites protected where the presence of the larvae would adversely affect concentrations of forest

visitors, or would cause unacceptable degradation of the environment in those areas.

- Protect municipal watersheds where an existing formal agreement is in place and where 100% defoliation would have unacceptable impacts on water quantity or quality. The criterion to measure the effects of each alternative and compare alternatives is the estimated potential for unacceptable degradation of water quality from increased sedimentation either from defoliation or from increased risk of secondary events such as fire.
- Protect designated foreground scenic Areas of Concern where defoliation would have a substantial adverse impact on scenery. The criterion to measure the effects of each alternative and to compare alternatives is the estimated acres of scenic foreground protected where defoliation would result in significant degradation of the designated scenic areas.
- Protect seed orchards and plantations of genetically superior trees where defoliation would result in a considerable loss of investment and a reduction of seed needed for future seedling demand. The criterion to measure the effects of each alternative and to compare alternatives is the number of orchards protected where unacceptable loss of investment and seed production would result.
- Protect areas where investments have already been made to protect Douglas-fir or other firs from bark beetles. The criterion to measure the effects of each alternative and to compare alternatives is the number of acres protected from defoliation that are currently being protected from bark beetles.

Note that the objective to protect Awarded Timber Sales described in the draft EIS was dropped. The reasons were 1) there are contract provisions to handle situations such as insect damage, and 2) sales identified to be protected were few and would be mostly harvested and logged within the year.

METHODS OF CONTROL

Two methods of control are evaluated in this document: treatment with a bacterial insecticide, B.t.k., and/or treatment with a viral insecticide, TM-BioControl. Use of either would achieve the desired insect suppression objectives. Both are registered by the U.S. Environmental Protection Agency.

B.t.k.: *Bacillus thuringiensis*, var. *kurstaki* is a bacterium that occurs naturally in the soil. When used as an insecticide, the bacteria spore and a toxic crystal produced by the spore are formulated into a liquid. The crystal is the primary active ingredient. In order to be toxic, the crystal must be ingested and activated by the alkaline gut system of a caterpillar. Once ingested, it causes paralysis of the gut system and the insect stops feeding. There are a number of varieties of B.t.; each is specific to certain insects. The variety *kurstaki* is specific to Lepidoptera (moths and butterflies). B.t.k. is applied as a spray at ½ 1 gal/acre.

B.t.k. is commonly used against a variety of forest defoliators and has been used to control DFTM. It was field tested against Douglas-fir tussock moth on various occasions in the early 1970s and was used operationally in 1989 on the Plumas NF. In 1991, 116,000 acres were treated for DFTM with B.t.k. on the Wallowa-Whitman NF. Between 1983 and 1993, it was used in a number of projects to control western spruce budworm on the Wenatchee, Umatilla, Wallowa-Whitman, and Malheur National Forests. Since Douglas-fir tussock moth and western spruce budworm both use the same host species, it is possible that many of the areas being considered for protection from Douglas-fir tussock moth have already been treated with B.t.k. once, and in some cases twice, in the past 15 years. The last B.t.k. treatment on any of these Forests occurred on parts of the Umatilla and Wallowa-Whitman Forests in 1992.

Field and laboratory testing has shown that certain insects can develop significant resistance through repeated exposure to B.t.k. However, it is unlikely that resistance would build up in tussock moth populations for a variety of reasons. B.t.k has little direct effect on natural enemies and development of DFTM individuals that do not receive a lethal dose of B.t.k is extended, allowing more exposure to natural parasites and viral infection. Furthermore, infrequent applications every 7 or 8 years, or longer, are generally not conducive to development of resistance.

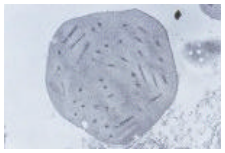


Photo I-2: DFTM

TM-BioControl: Nucleopolyhedrosis virus (photo, right) is the natural virus of the Douglas-fir tussock moth. It is one of the most infectious viruses known and its role in the collapse of DFTM outbreak populations is well documented. It can persist in soil at very low levels between outbreaks, and can remain viable for more than 40 years. Regardless of whether the Forest Service actively protects any lands under this project, this natural virus will eventually cause the Douglas-fir tussock moth outbreak to collapse. Complete resistance of tussock moth has never been found, either in extensive laboratory rearing or in field populations. If there were any resistance or natural selection for resistance against this virus, it would occur in response to the natural virus build up regardless of any applications of TM-BioControl. No resurgence of DFTM populations after treatment has ever been recorded. Besides Douglas-fit tussock moth, the virus affects only three other species of tussock moths.

The virus affects the gut system of the caterpillar, causing rapid death. In 1976, the USDA Forest Service registered this virus as a biological insecticide called TM-BioControl. The US Forest Service remains the sole producer, registrant, and owner of TM-BioControl. The powder is produced from infected caterpillars; it contains only the virus and ground-up insect body parts. It is mixed with water, molasses, a sunscreen, and a sticker (or a premixed

carrier called "038"), and is applied as a spray at 1 gal/acre. The Forest Service currently has an estimated 300,000 – 350,000-acre doses of TM-BioControl available.

TM-BioControl was used in DFTM suppression trials as early as the early 1960's. From 1970-1991, several studies of the virus in various formulations were conducted in Oregon, California, Idaho, and British Columbia. Each time, tussock moth populations were effectively controlled while populations in check plots continued to increase until the natural epizootic occurred. It was also used operationally in New Mexico in 1978 and 1979.

In all previous studies, trees treated with either B.t.k. or TM-BioControl sustained about 15 – 22% defoliation while untreated trees had about 63% defoliation.

In-depth risk assessments have been done for B.t.k.[3] and TM-BioControl[4], per National Research Council of the National Academy of Sciences recommendations.

SCOPING AND PUBLIC INVOLVEMENT

As required by the *National Environmental Policy Act, 40 CFR 1501.7*, a Notice of Intent ("NOI") was published in the *Federal Register* on June 18, 1999. This notice described the Forest Service proposal of managing the tussock moth outbreak and provided a 30-day comment period. Neither the nine National Forests nor the Regional Office received any comments during this period.

Following publication of the NOI in the *Federal Register*, each Forest sent a letter describing the Proposed Action and information specific to that Forest to interested citizens, organizations, businesses, and other governmental agencies on their mailing lists. Instructions in the scoping letters indicated that anyone wishing to comment on the Proposed Action should mail their comments to the Regional Office in Portland, Oregon. The Regional Office received 148 pre-addressed forms, individual letters, Internet contacts, and telephone comments. These came from private individuals, businesses, other governmental agencies, and organizations. Other public participation opportunities included interviews of Forest Service entomologists by Oregon Public Broadcasting, KPLU (Seattle, WA), and the *Walla Walla Union Bulletin*. Newspaper articles appeared in *The Blue Mountain Eagle* (John Day, Oregon) on June 30 and July 27, 1999; the *Bend Bulletin* (Bend, Oregon) on August 3, 1999; the *Baker City Herald* (Baker City, Oregon) August 10, 1999; and *The Oregonian* (Portland, Oregon) on August 11, 1999. These articles described the anticipated tussock moth outbreak and advised readers that the Notice of Intent was available, where to obtain a copy, and who to contact. Additionally, the Prineville-Crook County Chamber of Commerce included an article in their "Weekly Member Update" on August 2, 1999.

Please see Appendix C for more information.

[3] *Programmatic Gypsy Moth Environmental Impact Statement*. USDA, 1995.
[4] Syracuse Environmental Research Associates, Inc.

PROPOSED ACTION

The Forest Service proposes to spray B.t.k. and/or TM-BioControl on portions of nine National Forests. Active protection would only occur where outbreak or sub-outbreak populations of larvae have been verified. Up to 628,000 acres could be protection. Those areas where defoliation would result in degradation of threatened or endangered fish and wildlife habitats, recreation areas, or other Areas of Concern would be targeted. The biological agents would be applied primarily from the air, although ground application could occur in specific areas such as seed orchards.

This action is not designed to control the outbreak across the entire host type on the nine National Forests, only to protect specific Areas of Concern within these Forests. This proposal assumes there are adequate resources (insecticide, equipment, funding, etc.) for treatment. This proposal does not consider lands adjacent to National Forests.

Testing or development of new suppression technologies, such as mating disruption, could occur at some experimental sites. Agency personnel would conduct these tests. Other agencies or organizations could be involved in the research.

The Proposed Action would fully meet the stated goal of maintaining the functionality of current or desired future conditions of the identified Areas of Concern. This would be accomplished by protecting Douglas-fir and true firs from defoliation and death. The existing condition of riparian habitats, key habitat areas for specific wildlife species, recreation areas, and other identified Areas of Concern would be maintained.

ISSUES

Issues were identified by an Interdisciplinary Team (IDT) of Forest Service resource specialists, based on input received during the public scoping process. **Significant Issues** had the greatest influence during the development of alternatives. Both the Significant and **Other Issues** are used in the decision-making process.

SIGNIFICANT ISSUES

1. Human Health Effects

The Issue: There are many areas of human use not included in the Proposed Action, such as dispersed recreation areas, less used campsites, fishing spots, and general forest areas. Human health could be affected through direct contact with larvae. In addition, there was the concern of possible effects on human health from the spraying. The following criteria will be used to measure the effects of each alternative and to provide a method for comparing alternatives:

- Estimated potential for human exposure to larvae.
- Estimated potential for human exposure to B.t.k. or TM-BioControl during and after spray operations.

2. Protection of Timber Values

The Issue: Areas not included in the Proposed Action that contain commercially viable timber need to be protected to prevent mortality and loss of timber value. Evaluation criterion:

- Estimated volume of timber in host type on lands suitable and available for harvest that would lose value from mortality by not protecting the area.

3. Non-Target Lepidoptera

The Issue: B.t.k. could kill larvae of non-target Lepidoptera. Evaluation criterion:

- Estimated percent of overall decrease in non-target Lepidoptera over time.

4. Maintaining Healthy Forests

The Issues: a) Allow the natural cycle of tussock moth to thin out Douglas-fir and true fir trees, thus restoring a "healthy ecosystem"; b) Protect forests from tussock moth because dead or dying trees are a sign of an "unhealthy forest". Evaluation criteria:

- Estimated number of acres of dry site forest that would have host type reduced by defoliation, specifically where host type trees have become dominant due to fire suppression.
- Estimated acres protected from DFTM-related mortality.

OTHER ISSUES

5. Fuel Build-up and Fire Risk

The Issue: In unprotected areas, additional fuels could increase the risk of ignition and catastrophic fire. Evaluation criterion:

- Estimated number of acres of severely defoliated or dead trees that would significantly increase fire fuels.

6. Effects of Spraying on Fish and Wildlife

The Issue: Wildlife or fish could ingest insecticide. Evaluation criterion:

- Estimate of insecticide toxicity to fish and wildlife (excluding insects).

7. Water Quality

The Issues: a) Defoliation of unprotected riparian areas could affect stream temperature, peak flows, sediment input, etc.: b) The insecticide could pollute streams and lakes. Evaluation criteria:

- Estimated potential for increased stream temperature. Number of stream miles in 60 – 100% host type not protected as an indication of potential stream temperature increase.
- Estimated potential for increased sedimentation.
- Estimated potential for increased nitrogen from tree needle decomposition and insect frass.
- Risk of adverse effect of B.t.k. or TM BioControl on water quality that could result in problems to fish, animals, or humans.

8. Economic Effects from Decreased Tourism

The Issue: Protection of recreation areas could help local communities by maintaining tourist and recreation income. Evaluation criterion:

- Estimated loss of revenues to local communities because of degraded recreation areas.

9. Tussock moth larvae could increase the food supply for wildlife species

The Issue: Killing tussock moth larvae could reduce the opportunity for certain wildlife to take advantage of a food surplus. Evaluation criterion:

- Estimated tussock moth population reductions.

10. Operations

The Issue: Spraying could cause environmental problems or limit access to the forest during operations. Examples include fuel spills, helicopter crashes, noise, and road closures during operations. Evaluation criterion:

- Estimated potential for spills and accidents.

11. Secondary Mortality

The Issue: Weakened trees that survive the tussock moth infestation could die from secondary attacks by bark beetles or other forest pathogens. Evaluation criterion:

- Estimated additional increase in percentage of mortality from secondary insects and disease.

SPECIAL MANAGEMENT CONSIDERATIONS

Within the potential tussock moth outbreak area, there are about 1,655,750 acres that contain 20-60% host type (see Glossary) trees and 2,587,000 acres that contain 60-100% host type trees. Of the 4,242,750 total acres being analyzed, not all would be affected. Additionally, the Forest Service is not able to predict exactly which trees will be defoliated. Therefore, the analysis in this document only covers the acres that could be protected should an outbreak occur. ***"Blanket" spraying over all National Forests is NOT proposed under any alternative. Active protection would only occur in areas identified in the selected alternative where tussock moth larvae are at sub-outbreak or outbreak*** *levels***.** Individual populations could reach outbreak levels at different times; thus, treatment could occur anytime between the years 2000 and 2004.

The number of acres that can be treated with TM-BioControl is limited. It would not be possible to produce additional virus for the current outbreak. TM-BioControl was produced at a Forest Service facility in Corvallis, Oregon from 1981 to 1995. It would take 9-10 years to produce this same quantity of new virus for future

outbreaks. This is because of the time required to reestablish the manufacturing facility and to rear sufficient numbers of tussock moths to produce an adequate supply of the virus.

REGULATIONS, DIRECTION, AND POLICIES

This environmental impact statement has been prepared in accordance with regulations established under the National Environmental Policy Act of 1969. Implementation of any alternative will comply with applicable local, State, and federal laws, regulations, or policies.

Resource objectives are established in the land management plans of each of the Forests covered by this document. Contained within these management plans are standards and guidelines for pest management. There are excerpts of these standards and guidelines in Appendix F. For a complete list of standards and guidelines for each Forest, it will be necessary to refer to that Forest's Land and Resource Management Plan.

Resource direction is also provided by the *1994 Final Supplemental Environmental Impact Statement on Management of Habitat for Late Successional and Old Growth Forest Related Species Within the Range of the Northern Spotted Owl and Record of Decision*[5]. Additional objectives are described in the *1995 Decision Notice for the Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales, Regional Forester's Amendment #2*.

Any Forest Service use of an insecticide must comply with the terms of the *Federal Insecticide, Fungicide, and Rodenticide Act of 1972*, as amended. The Forest Service must meet all Environmental Protection Agency air and water quality standards. The EPA is directly responsible for regulating the availability and use of pesticide products. The Forest Service must comply with all terms of the *1973 Endangered Species Act* and ensure that viable populations of sensitive species be maintained and do not become threatened or endangered as a result of Forest Service actions.

The Forest Service uses the Integrated Pest Management ("IPM") approach. This strategy incorporates pest monitoring, prevention, suppression, and evaluation. The intent of the prevention component is to avoid creating ecological conditions that foster pests, or to correct management-created conditions that would allow continued pest problems. The prevention component is implemented through long term management strategies such as those found in the forest management plans.

The suppression component is a short term management action aimed at protecting vegetative conditions and involves selecting a single tactic, concurrent measures, or a sequence of tactics. Suppression can be direct or indirect. Direct suppression methods are usually applied to existing pest populations with the intent of limiting damage to a tolerable level. Examples of direct suppression include spraying insecticides or releasing parasites or predators. Indirect suppression involves altering conditions that foster pest population growth. Examples include silvicultural activities to reduce stand density or to change the vegetation component. Post-suppression activities involve monitoring to determine the effectiveness and efficiency of the suppression. Effectiveness evaluations are based on the change in net resource value rather than changes in pest population numbers. To improve overall program performance, information gathered during evaluation is fed back into the system, and appropriate adjustments are made to pest management strategies.

The advantage of using an integrated pest management approach is the consideration given to other potential pest problems when analyzing specific situations. The goal is to avoid creating or intensifying one pest problem while attempting to alleviate another. The strength of the IPM philosophy is that it requires pest management be incorporated into the broad arena of forest and range management.

DECISIONS TO BE MADE

This Environmental Impact Statement informs the Pacific Northwest Regional Forester (the Deciding Official) of the direct, indirect, and cumulative effects to the environment of the Proposed Action and all alternatives. This document also informs the public of management proposals and the potential effects on the environment by these actions.

In the Record of Decision, the Regional Forester can decide to:

1) Allow DFTM populations to follow a natural course of population buildup and decline on all 4.2 million acres of forested host type identified in this analysis (No Action Alternative).

2) Apply B.t.k. and/or TM-BioControl on Areas of Concern where the tussock moth population levels have reached sub-outbreak or outbreak levels within the 628,000 acres evaluated in the Proposed Action. DFTM populations would follow a natural course of population buildup and decline on all other acres of forested host type identified in this analysis (Proposed Action).

3) Apply B.t.k. and/or TM-BioControl on all lands where tussock moths have reached sub-outbreak or outbreak levels within the 2.5 million acres evaluated under the Expanded Protection Alternative. DFTM populations would follow a natural course of population buildup and decline on all other acres of forested host type identified in this analysis (Expanded Protection Alternative).

4) Apply TM-BioControl only on Areas of Concern where tussock moths have reached sub-outbreak or outbreak levels within the 628,000 acres evaluated under the virus only alternative. DFTM populations

[5] Also known as the "*Northwest Forest Plan*"

would follow a natural course of population buildup and decline on all other acres of forested host type identified in this analysis (TM-BioControl Only alternative)

5) Modify which areas would be protected in any action alternative. Modify or stipulate which insecticide would be used in specific areas to be protected or under specific conditions or circumstances.

CHAPTER II: ALTERNATIVES, INCLUDING THE PROPOSED ACTION

SUMMARY OF CHANGES BETWEEN DRAFT AND FINAL

Numbering of alternative was dropped. The alternatives are defined by name only. In the draft, Alternative 1 was the Proposed Action. It is now referred to as the "Proposed Action". In the draft, Alternative 2 was the called "Expansion of Protected Areas". It is now referred to as the "Expanded Protection Alternative". In the draft, Alternative 3 was the No Action Alternative. It is now referred to as the "No Action Alternative" and appears first in all discussions.

Order of alternatives was rearranged to provide smoother transitions.

Provided a more detailed description of each alternative.

A Virus Only Alternative was analyzed in response to public comment (previously listed as considered but not evaluated in detail).

DEVELOPMENT OF ALTERNATIVES

The need for action was based on results of the Douglas-fir Tussock Moth Early Warning Trapping System. A substantial increase in moth populations, toward outbreaks levels, suggested to the Forest Service a need for immediate action. Please refer to Appendix D for more information on the Early Warning Trapping System and tussock moth population sampling.

The analysis was limited to mitigating the impacts of the current outbreak, expected to occur between 2000 and 2004. Because of the immediacy of the outbreak, any action, would need to be implemented beginning in spring, 2000. Once the Purpose and Need had been identified, an interdisciplinary team (IDT) was formed to develop and evaluate various protection alternatives.

The IDT refined the Proposed Action to make it more specific. The IDT also defined potential issues and reviewed public comments, resulting in the creation of alternatives to the Proposed Action. Potential alternatives not selected for further analysis are described in "Alternatives Considered but Eliminated from Detailed Study", page II-6.

Emphasis items or concerns expressed by participants during the scoping phase included:

1. A desire to avoid conditions similar to the outbreak of the early 1970's.
2. Concern that the timber should be included as a resource to be protected.
3. Belief that dispersed recreation areas are also important areas to protect.
4. Need to analyze the health effects on humans from contact with moth larvae and from the insecticide(s).
5. The concept of maintaining "forest health" as defined by allowing the natural cycle to occur and by keeping trees alive.

ALTERNATIVES CONSIDERED IN DETAIL

Four alternatives (a No Action, and three action alternatives) are described below. These alternatives have potential effects across the landscape of each Forest. Please refer to Appendix A for specific information on Forest management allocation areas where activities could occur.

NO ACTION ALTERNATIVE

This alternative is required per *40 CFR 1502.14(d)* but was also mentioned in public comment letters. Concerns for a No Action choice included allowing the insect to evolve through its "natural" life cycle without interruption, allowing trees to be naturally defoliated, and known or unknown effects of insecticides.

The No Action Alternative would preclude all tussock moth control activities. Other activities scheduled under other environmental documentation would continue. It would not meet the identified purpose and need.

PROPOSED ACTION

This is essentially the Proposed Action described during public scoping in August 1999. The Forest Service proposes to protect 628,000 acres from defoliation by the Douglas-fir tussock moth on portions of nine national forests. Protection would be by spraying B.t.k. and/or TM-BioControl. Spraying would **only occur where outbreak or sub-outbreak populations of larvae have been verified**. Those areas where defoliation would result in degradation of threatened or endangered fish and wildlife habitats, recreation areas, or other Areas of Concern would be targeted. The biological agents would be applied primarily from the air, although ground application could occur in specific areas such as seed orchards. In unprotected areas, the insect would evolve through its natural life cycle without interruption.

This action is not designed to control the outbreak across the entire host type on the nine National Forests, only to protect specific Areas of Concern within these Forests. This proposal assumes there are adequate resources (insecticide, equipment, funding, etc.) for treatment. This proposal does not consider lands adjacent to National Forests.

Testing or development of new suppression technologies, such as mating disruption, could occur at some experimental sites. Agency personnel would conduct these tests. Other agencies or organizations could be involved in the research.

The Proposed Action would meet the stated goal of maintaining the functionality of current or desired future condition of the identified Areas of Concern. This would be accomplished by protecting Douglas-fir and true firs from defoliation and death. The existing condition of riparian habitats, key habitat areas for specific wildlife species, recreation areas, and other identified Areas of Concern would be maintained.

Two Areas of Concern are in Wilderness:

- Lake Chelan-Sawtooth Wilderness (Okanogan NF): 5,850 acres where defoliation would cause an unacceptable increase of fuels and resultant fire risk to adjacent facilities and private property.
- North Fork Umatilla Wilderness (Umatilla NF): 5,890 acres of anadromous and bull trout habitat, and late/old structure stands where defoliation would result in unacceptable degradation of habitat.

Table II-1: Areas Protected under the Proposed Action and TM-BioControl Alt., in acres

FOREST→	COL	OKA	WEN	UMA	W-W	MAL	OCH	WIN	FRE[6]	TOTAL
Bark Beetle Protection	0	0	3,260	0	800	3,600	0	0	0	7,660
Fish – Anadromous	0	0	1,230 (18 miles)	27,610 (179 mi.)	6,490 (92 miles)	2,170 (31 mi.)	7,190 (102 mi.)	0	0	44,690 422 mi.
Fish - Bull Trout	0	270 (4 mi.)	340 (5 mi.)	23,380 (98 mi.)	6,010 (85 mi.)	2,700 (39 mi.)	0	0	190 (3 mi.)	32,890 (234 mi)
Late Succ. Reserves (LSRs)	0	16,600	74,800	0	0	0	0	0	0	91,400
Nesting Hab. Spotted Owl	0	3,000	32,000	0	0	0	0	1,600	0	36,600
Nesting Habitat Bald Eagle	0	0	0	50	0	0	0	0	0	50
Old Growth	0	0	0	18,570	17,660	14,950	55,450	23,100	0	129,730
Late & Old Structure				17,200	83,440	28,860	64,680			194,180
Recreation: high use areas	7,100	1,940	110	3,230	10,940	140	4,200	20	0	27,680
Residential & Admin.	0	120	8,650	940	0	60	240	150	0	10,160
Scenic	0	98,130	4,840	67,270	0	33,630	7,650	0	0	211,520
Seed Orchards	150 (5 Orchards)	420 (2 Orch.)	0	180 (3 Orch.)	360 (6 Orch.)	0	0	0	0	935
Municipal Watershed	0	0	0	12,280	8,740	150	540	0	0	21,710
Other	0	0	610	20	0	14,860	0	1,510	0	17,000
Total[7]	**7,260**	**122,070**	**93,330**	**130,310**	**110,520**	**72,910**	**66,680**	**24,610**	**190**	**627,880**

[6] Includes the Demming Creek watershed only.
[7] The columns do not necessarily add up to the "Total" acres since there is some overlap among Area of Concern categories.

EXPANDED PROTECTION ALTERNATIVE

This alternative proposes to protect 2,505,200 acres from defoliation by the Douglas-fir tussock moth on portions of nine national forests. Protection would be by spraying B.t.k. and/or TM-BioControl. Spraying would **only occur where outbreak or sub-outbreak populations of larvae have been verified**. Areas protected would include the Areas of Concern as described in the Proposed Action, and all other threatened National Forest lands outside Wilderness with 60-100% host type. No additional Wilderness areas would be included that are not already protected in the Proposed Action. The intent of this alternative is to protect all Areas of Concern, and most of the host type acres that could be significantly affected. This action is not designed to control the outbreak across the entire host type on the nine National Forests. The biological agents would be applied primarily from the air, although ground application could occur in specific areas such as seed orchards. In unprotected areas, the insect would evolve through its natural life cycle without interruption.

Testing or development of new suppression technologies, such as mating disruption, could occur at some experimental sites. Agency personnel would conduct these tests. Other agencies or organizations could be involved in the research.

If implemented, this alternative would exceed the stated purpose and need.

Table II-2: Areas Protected under the Expanded Action Alternative, in acres

FOREST→	COL	OKA	WEN	UMA	W-W	MAL	OCH	WIN	FRE[8]	TOTAL
Areas of Concern protected in Proposed Action & TM-BioControl Alt.	7,260	122,070	93,330	130,310	110,520	72,910	66,680	24,610	190	627,880
Additional Acres Protected this Alt.	551,190	261,690	31,570	349,530	368,550	260,980	6,570	46,590	660	1,877,330
Total, this Alt.	558,450	383,760	124,900	479,840	479,070	333,890	73,260	71,200	850	2,505,220
Total Acres of 20-60% Host Type Not Protected	621,560	493,170	176,620	931,870	959,700	706,070	112,700	237,350	3,710	4,242,750

[8] Includes the Demming Creek watershed only.

TM-BioControl Only Alternative

This alternative was evaluated in detail following public review of the Draft Environmental Impact Statement, primarily because of possible affects of B.t.k. on non-target Lepidoptera. This alternative would protect the same Areas of Concern as the Proposed Action, but with TM-BioControl only. The current supply of TM-BioControl is probably enough to protect Areas of Concern reaching sub-outbreak / outbreak population levels of the tussock moth, but there is some risk there is not enough. The Forest Service proposes to spray the virus insecticide on a "first come, first served basis" after reserving enough TM-BioControl to protect potential outbreaks in threatened or endangered bull trout and anadromous fish habitat, and spotted owl nesting, roosting, and foraging areas. Later, if it looks like the supply of TM-BioControl will run out, Forest Supervisors will set priorities for protection of the remaining areas. Once the current inventory is exhausted, all active protection would stop. This action is not designed to control the outbreak across the entire host type on the nine National Forests, only to protect specific Areas of Concern within these Forests.

If implemented, this alternative would meet the stated goal of maintaining existing and desired future condition of specific Areas of Concern if the TM-BioControl supply is not exhausted before the outbreak is over. Selection of this alternative will remove the TM-BioControl option as an alternative for other federal land managers because the existing supply would probably be depleted. Please refer to Table II-1, **Error! Bookmark not defined.** for specific protection areas.

Alternatives Considered but Eliminated from Detailed Study

Suppression of the Entire Outbreak

This alternative considered protecting all areas of Douglas-fir tussock moth outbreak that could occur on the nine National Forests t. This would require protection on over 4.2 million acres, a much larger area than proposed in the other alternatives. In addition to Areas of Concern and 60-100% host type identified in the other alternatives, this alternative would protect all 20-60% host type.

The Douglas-fir tussock moth is a native insect, with an important role in the disturbance ecology of the forests where it occurs. Past management practices and fire suppression have allowed firs to become established in sites that were traditionally pine and larch. This has led to forests with more host trees than historic conditions. Especially in mixed stands of 20-60% host type, Douglas-fir tussock moth acts as a "thinning" agent. The result is less competition for surviving trees, short term increases in nutrients, and new forest openings. This alternative would not facilitate a long-term management strategy of allowing natural disturbances to restore overall ecosystem health.

In addition, the logistics of treating the entire potential outbreak would require a broader, landscape approach to treatment. This could result in treating many areas that would not need or particularly benefit from, treatment.

Suppression with Other Insecticides

This alternative considered using carbaryl, diflubenzuron, or tebufenozide instead of B.t.k. or TM-BioControl. Carbaryl is a relatively broad-spectrum insecticide. Several formulations of carbaryl, such as Sevin-4-Oil™, are registered for use on Douglas-fir tussock moth. Its primary mode of action is through ingestion, although there is also some contact toxicity. Use of this insecticide would be under similar conditions and situations as B.t.k or TM-BioControl.

The effects of carbaryl are not limited to specific insects. It affects a number of non-target insects and is particularly toxic to honey bees. Although it is commonly used in the human environment as a garden insecticide and on pet flea collars, its overall environmental impact on other insects would be greater than the insecticides proposed for use. Furthermore, State and Federal regulations prohibit carbaryl application near streams and open water. Since protecting trees in riparian areas is one of the primary objectives of this project, using carbaryl would not meet some project needs. Some formulations of carbaryl require mixing with fuel oil as a carrier. Application of fuel oil on the forest environment could have additional impacts.

Diflubenzuron (Dimilin™) prevents the chitin, a protein that is the building block of an insect exoskeleton from depositing properly. As a result, the insect is not able to molt properly due to a lack of chitin in the new cuticle. Exposure may be dermal, but the primary route is through ingestion. Ovicidal effects may also occur (USDA FS and Aphis, 1995). It has been tested in the laboratory (Robertson, 1978) and in field tests against the Douglas-fir tussock moth (Hard, 1978). In most cases, population reduction did not occur for 14 days after treatment, presumably because diflubenzuron is a growth regulator and its lethal action is delayed. When applied shortly after egg hatch, larval populations and damage were significantly reduced (Hard, 1978). Diflubenzeron affects insects, other arthropods, and some fungi. Lepidoptera are the group most severely affected by diflubenzuron, however, it also affects other insects. Effects have been noted on lacewings, ladybird beetles, immature big-eyed bugs, and earwigs, as well as some of the natural parasites and predators of the insects. It affects honeybees, spiders, and mites. Invertebrates of freshwater habitats, especially crustaceans and insects, are subject to population reductions from diflubenzuron (USDA FS and APHIS, 1995). Application near streams and open water would be prohibited.

Use of tebufenozide for control of Douglas-fir tussock moth was authorized by the Environmental Protection Agency after this EIS was initiated. Tebufenozide (Mimic™) is an insecticide that mimics the natural insect molting hormone, eventually causing the larvae to develop an inferior exoskeleton. It must be ingested to be effective. Tebufenozide is considered "reduced-risk" as it

is specific only to Lepidopteran larvae; it does not affect other insects (Rhom and Haas, 1994). Although it has been successfully field tested against the closely related Whitemarked tussock moth (*Orgyia leucostigma*) (Thurston and Kettala, 1998), there is no information indicating tebufenozide has been field tested or used against Douglas-fir tussock moth.

For these reasons, use of carbaryl, diflubenzeron, or tebufenozide for this project was not analyzed in detail.

Douglas-fir Tussock Moth Mating Disruption

Since the DFTM female does not fly, her ability to reproduce is dependent on her success in attracting a mate. The female moth produces a pheromone that attracts the male moths and helps them locate her. Mating disruption techniques saturate an area with synthetic pheromone. This confuses male moths, making them unable to locate the real female. The mating disruption of Douglas-fir tussock moth has been effective in experimental field tests. However, several questions must be answered before it can be recommended as an operational control option. These include the maximum size of the treatment area in which this treatment can be effective, the appropriate dose, and the appropriate application and delivery systems. More importantly, the Douglas-fir tussock moth pheromone is not currently registered by EPA for use in controlling tussock moth.

Protection of Areas of Concern Plus Silvicultural Treatments

This alternative proposed control of the expected tussock moth outbreak (as described in the Proposed Action) plus a variety of silvicultural treatments to address potential future outbreaks. Harvest, tree planting, thinning, and prescribed burning, would occur on 300,000 acres in addition to those described in the Proposed Action.

This alternative was eliminated from further consideration because it is beyond the scope of this analysis. Long-term forest management strategies have been addressed in Forest Plans and other documents and in analyses such as the Interior Columbia Basin Ecosystem Management Project ("ICBEMP") now underway. Site-specific analysis for areas identified for silvicultural treatments would be done at the Forest level. Please also see Appendix G for guidelines related to project implementation.

Mitigation Measures

Mitigation Measures are actions taken to avoid, minimize, reduce, or eliminate the impacts of implementing an alternative. The following mitigation measures would apply to all action alternatives:

Apply only TM-BioControl:

- ✓ Anadromous fish and bull trout habitat.
- ✓ Spotted owl activity centers on the Okanogan, Wenatchee, and Winema National Forests.
- ✓ Showy Stickseed and Wenatchee Mountain Checkermallow habitat (specifically, Showy Stickseed buffer – T25N R17E Sections 13-16, 21-28, 33 - 36; T24N R17E Sections 2-5; Wenatchee Mt. Checkermallow buffer– T23N R18E; T23N R18E Sections 2-6, 7-11; T22N R18E Sections 2-6, 7-11; T23N R17E Sections 3,10,15,22,27,34; T22N R17E Sections 2,3,10,11). These plants are pollinated by Lepidoptera (moths and butterflies.
- ✓ Yellow-cedar grove on the Malheur NF.
- ✓ Research plots (1 mile radius) associated with neo-tropical bird studies on the Okanogan, Wallowa-Whitman, and Ochoco National Forests.
- ✓ Known Mardon skipper colonies in proposed protection areas in Klamath County, Winema National Forest.
- ✓ Wilderness on the Okanogan and Umatilla National Forests.
- ✓ Areas adjacent to Wilderness.

Avoid treatment:

- o 1.75 mile radius around Townsend's Big-Eared bat maternity sites.
- o Pacific Northwest Research Natural Areas.
- o ½- 1 mile buffer around active bald eagle nests as defined in specific Forest Plans and the Northern Bald Eagle Pacific Recovery Plan, except near an important, isolated habit on the Umatilla NF.
- o 1 mile buffer around active Peregrine falcon nests.

Monitoring

Please refer to Appendix I for information on implementation monitoring (the Monitoring Plan).

Features Common to All Action Alternatives

Most spray will be applied by helicopter. Ground application could occur in small, accessible areas such as campgrounds. The insecticide will usually be sprayed as a single application by a helicopter flying 50 – 75' above the tree tops, with an average swath width of about 90'. This would result in only a momentary presence of the aircraft at any location.

The safe and efficient contract application of pesticides by helicopter in mountainous terrain makes small isolated areas impractical for treatment. In order to safely and efficiently meet project objectives, spray blocks could include some areas not specifically identified for protection. Generally, such inclusions are irregularly shaped. Where practical and possible, some of these areas outside identified protection zones will not be sprayed by turning off the spray equipment during application. Feasibility will depend on operational factors such as safety, mapping, and contractor capability to perform.

Conversely, small, isolated areas specifically approved for protection could be excluded from spray block delineation for the same reasons.

In some cases, there may be small parcels of state or private land (less than 160 acres) surrounded by federal lands ("in-holdings") where protection from defoliation would contribute to project objectives. The most likely scenario is adjacent National Forest lands that have been identified for protection in the selected alternative and whose moth populations have reached sub outbreak / outbreak levels. In such cases, the Forest Service could treat those areas if permission of the landowner had been obtained and after meeting state requirements.

MANAGEMENT CONSIDERATIONS REGARDING THE USE OF TM-BIOCONTROL

The USFS is the sole owner registrant, and producer of TM-BioControl. All of the existing product is maintained in the Pacific Northwest Region. However, the intent has always been to make it available to other agencies, such as the Bureau of Land Management, National Park Service, and other National Forest in other Regions. As stated previously, the supply of TM-BioControl is limited. Implementation of any of the action alternatives could deplete the existing supply. Thus, the option to use TM-BioControl by other agencies could be removed.

COMPARISON OF ALTERNATIVES BY OBJECTIVE AND ISSUE

[Editor's Note: the reader is encouraged to now read Chapters 3, Existing Conditions and Chapter 4, Effects Analysis. By familiarizing oneself with that information which includes the derivation of the numbers, the following comparison of alternatives will be more meaningful].

SUMMARY OF ENVIRONMENTAL CONSEQUENCES

Table II-3: Effects Analysis, by Alternative

CRITERIA	NO ACTION ALTERNATIVE	PROPOSED ACTION & TM-BIOCONTROL ONLY ALTERNATIVE	EXPANDED PROTECTION ALTERNATIVE
Measurement Criteria for Objectives			
Miles of T&E fish streams protected / miles of T&E fish 303[d] listed stream segments protected - where defoliation results in unacceptable degradation of occupied habitat especially important spawning and rearing habitat	Anadromous: All Forests = 0 miles Bull Trout: All Forests = 0 miles	Anadromous: Okanogan = 0 Wenatchee = 18 / 4 Umatilla = 179 / 110 W-W = 92 / 40 Malheur = 31 / 23 Ochoco = 102 miles / 30 miles Total = 422 / 207 Bull Trout: Colville = 0 Okanogan = 4 / 0 Wenatchee = 5 / 3 Umatilla = 98 / 49 W-W = 85 / 34 Malheur = 39 / 24 Fremont = 3 / 2 Total – 234 / 112	Anadromous: Total = 925 / 334 The additional miles over the Proposed Action would not be in areas where unacceptable degradation would occur Bull Trout: Total = 443 / 162 Same as Anadromous above
Number of spotted owl activity center sites protected - where defoliation results in unacceptable degradation of nesting, roosting, and foraging habitat.	All Forests = 0 sites	Okanogan = 5 Wenatchee = 112 Winema = 2 Total = 119	Same as Proposed Action
Late-Successional Reserve acres protected – (where defoliation could result in un-acceptable degradation of late successional habitat) */ acres protected for other objectives.*	All Forests = 0 acres	Okanogan = 16,600 / 30,900 Wenatchee = 74,800 / 0 Total = 91,400 / 30,900	Okanogan = 16,600 / 18,500 Wenatchee = 74,800 / 19,300 Total = 91,400 / 37,800
Acres of OG or LOS area protected (where defoliation results in substantial degradation of habitat values) */ acres protected for other objectives.*	All Forests = 0 acres	Colville = 0 / 0 Okanogan = 19,710 / 8,200 Wenatchee = 9,480 / 13,000 Umatilla = 14,640 / 4,000 W-W = 63,210 / 32,800 Malheur = 29,820 / 8,700 Ochoco = 28,530 / 34,400 Winema = 0 / 8700 Total = 165,390 / 109,800	Colville = 0 / 118,000 Okanogan = 19,710 / 52,990 Wenatchee = 9,480 / 17,020 Umatilla = 14,640 / 6,360 W-W = 63,210 / 47,090 Malheur = 29,820 / 114,780 Ochoco = 28,530 / 35,000 Winema = 0 / 32,600 Total = 165,390 / 426,840

CRITERIA	NO ACTION ALTERNATIVE	PROPOSED ACTION & TM-BIOCONTROL ONLY ALTERNATIVE	EXPANDED PROTECTION ALTERNATIVE
Number of residential and administrative sites protected where the presence of the larvae would adversely affect people where they work and live, or would cause unacceptable degradation of the environment in the area	All Forests = 0 sites	Okanogan = 7 Wenatchee = 7 Umatilla =15 Malheur = 1 Ochoco = 4 Winema = 2 Total = 36	Same as Proposed Action
Number of high use, developed recreation sites protected where the presence of the larvae would adversely affect concentrations of forest visitors, or would cause unacceptable degradation of the environment in those areas	All Forests = 0 sites	Colville = 12 Okanogan = 69 Wenatchee = 27 Umatilla = 31 W-W = 7 Malheur = 16 Ochoco = 10 Total = 172	Same as the Proposed Action
Estimated potential for unacceptable degradation of water quality from increased sedimentation either from defoliation or from increased risk of secondary events such as fire in Municipal Watersheds	There are 5 municipal watersheds. No significant sedimentation from defoliation is expected. Secondary effects include increased risk for fire and sedimentation.	4 watersheds (Baker City, City of Sumpter, Canyon City, Walla Walla) protected from defoliation and subsequent increased risk from fire	Same as the Proposed Action
Estimated acres of scenic foreground protected where defoliation results in significant degradation of designated scenic areas.	All Forests = 0 acres	Okanogan = 21,900 Wenatchee = 2,240 Umatilla = 33,520 Malheur = 16,060 Ochoco = 1,790 Total = 75,510	Additional scenic areas in scenic foreground, scenic middle ground, and scenic background where no significant degradation of scenic values would occur.
Number of orchards protected where an unacceptable loss of investment and seed production would result.	All Forests = 0 orchards	Colville = 5 Okanogan = 2 Umatilla = 3 W-W = 6 Total = 16	Same as the Proposed Action
Number of acres protected from defoliation that are currently being protected from bark beetles	All Forests = 0 acres	Wenatchee = 3,260 Malheur = 3,600 W-W = 800 Total = 7,660	Same as the Proposed Action
Measurement Criteria for Issues			
Estimated potential for humans to come in contact w/larvae.	High	Low	Very low
Estimated potential for humans to be exposed to pesticide.	None	Low	Moderate

CRITERIA	NO ACTION ALTERNATIVE	PROPOSED ACTION & TM-BIOCONTROL ONLY ALTERNATIVE	EXPANDED PROTECTION ALTERNATIVE
Worst case scenario - Estimated volume (in thousands of board feet) of dead timber in host type in areas available for harvest. Please also see Appendix K. ***A scenario based on experience from the 1972/73 outbreak*** as applied only to areas available for harvest.	Colville = 105,080 mbf Okanogan = 22,900 Wenatchee = 48,380 Umatilla = 251,000 W-W = 264,580 Malheur = 45,120 Ochoco = 52,530 Winema = 4,490 Fremont = 120 Total = 794,200 Total = 130,000 mbf	Colville = 102,340 mbf Okanogan = 18,820 Wenatchee = 13,840 Umatilla = 200,810 W-W = 209,840 Malheur = 34,340 Ochoco = 8,940 Winema = 3,400 Fremont = 10 Total = 592,340 Total = 100,000 mbf	Colville = 30 mbf Okanogan = insignificant Wenatchee = insignificant Umatilla = 10 W-W = 20 Malheur = insignificant Ochoco = insignificant Winema = insignificant Fremont = insignificant Total = 100 Total = 100 mbf
Estimated impact of non-target Lepidoptera that could be affected.	Low	TM BioControl Alt. - Low Proposed Action Alt. - Mod.	High
Dry site acres of dense high risk host type that could be defoliated ***Dry site acres protected*** Note: In all action alternatives, Areas of Concern are protected to meet the purpose and need objectives. The protection in the Expanded Protection Alternative exceeds those objectives.	Colville/Okanogan/Wenatchee 84,000 Acres Umatilla/W-W/Malheur/Ochoco 308,100 Acres Winema/Fremont Small amount	Colville/Okanogan/Wenatchee 65,600 Acres Umatilla/W-W/Malheur/Ochoco 210,800 Acres Winema/Fremont Small amount Colville/Okanogan/Wenatchee 19,000 Acres Umatilla/W-W/Malheur/Ochoco 97,300 Acres Winema/Fremont Small amount	All Forests = 0 acres Colville/Okanogan/Wenatchee 84,000 Acres Umatilla/W-W/Malheur/Ochoco 308,100 Acres Winema/Fremont Small amount
Estimated acres of mortality, severe, or moderate defoliation that would cause significant increase in fuels for fire	Total = 360,110	Total = 285,670 Areas of Concern would be protected with subsequent prevention of increased fire risk in those areas.	Total = 108,230 Areas of Concern would be protected with subsequent prevention of increased fire risk in those areas.
Estimate of the insecticide(s) toxicity to wildlife (excluding insects) and fish species	No effect	Effects would be minimal or non-existent.	Effects would be minimal or non-existent.

CRITERIA	NO ACTION ALTERNATIVE	PROPOSED ACTION & TM-BIOCONTROL ONLY ALTERNATIVE	EXPANDED PROTECTION ALTERNATIVE
Estimated potential for effects on temperature (***Stream miles in 60 – 100% host type not protected*** as a measurable factor that may contribute to an increase in stream temperature)	Colville = 1,100 miles Okanogan = 740 Wenatchee = 158 Umatilla = 1,440 W-W = 1,280 Malheur = 815 Ochoco = 85 Winema = 80 Fremont = 2 Total = 5,700	Colville = 1,085 miles Okanogan = 560 Wenatchee = 80 Umatilla = 1,080 W-W = 1,105 Malheur = 740 Ochoco = 20 Winema = 80 Fremont = 0 Total = 4,750	Colville = 35 miles Okanogan = 90 Wenatchee = 15 Umatilla = 340 W-W = 135 Malheur = 65 Ochoco = 10 Winema = 20 Fremont = 0 Total = 710
Estimated potential for effects on sedimentation & Nitrogen	Increases would not be measurable from defoliation only. For sedimentation, a secondary effect is increased risk towards severe fire with sedimentation as an aftermath.	Increases would not be measurable from defoliation only. The secondary effect for fire risk is a little less than the No Action Alternative.	Increases would not be measurable from defoliation only. The secondary effect for fire risk is a significantly less than the No Action Alternative
Estimated loss of revenue to local communities as a result of degraded recreation areas.	Where high use facilities and popular forest areas are located, local communities would expect to experience significant loss of revenue in the short term – and loss of revenue would accrue until replacement trees begin to take form.	High use recreation facilities would be protected preventing most loss of revenue for those local communities. The expanded landscape would not be protected and dispersed recreation opportunity would be reduced. Income opportunity would be available from spray operations.	Both high use recreation facilities and expanded areas in host type would be protected. Most all areas of high risk for outbreak would be protected, thus minimizing any reduction of income from recreation. Local income opportunity would be available from spray operations.
Estimated insect population level reductions.	No treatment would occur. Wildlife would be opportunistic by feeding on high levels of insects for one to two years. After population collapse, wildlife would revert to feeding habits associated with non-outbreak populations.	In treatment areas, DFTM populations would return to non-outbreak levels. There would be fewer chances for opportunistic feeding. Wildlife would maintain feeding habits associated with non-outbreak populations.	In treatment areas, DFTM populations would return to non-outbreak levels. There would be fewest chances for opportunistic feeding. Wildlife would maintain feeding habits associated with non-outbreak populations.
Estimated potential risk for spills and accidents.	There would be no risk of accidents or spills related to spraying.	This alternative would have fewer risks than Expanded Protection Alternative due to the size of the areas being treated.	This alternative poses the highest risk for spills or accidents due to the size of the areas being treated.
Estimated secondary mortality that could occur from infestations from bark beetles.	Estimate 6 to 43 % secondary mortality on defoliated acres on 4.3 million acres.	Estimate 6 to 43% secondary mortality on defoliated acres on 3.8 million acres.	Estimate 6 to 43 % secondary mortality on defoliated acres on 1.8 million acres.

Chapter III: EXISTING CONDITIONS of the AFFECTED ENVIRONMENT

SUMMARY OF CHANGES BETWEEN DRAFT AND FINAL

Separated Existing Conditions and Effects Analysis into two chapters.

Reorganized discussion of existing conditions to provide more detailed information in a clearer format.

Organized most resource categories to correspond to project objectives.

Included more information on fish and wildlife species.

More prominently displayed information on the role of tussock moth in the natural environment.

INTRODUCTION

This chapter describes the existing condition of the environment and provides a baseline for comparison of alternatives. It describes the resources that could be affected by implementation of any alternative. Where possible, these resources are organized to reflect project objectives.

FOREST HEALTH

OVERVIEW

Mountainous regions of eastern Oregon and Washington are dominated by coniferous forests. These forests can be described by *series*, related plant associations named after the dominant climax conifer. Four series provide habitat for tussock moth: Douglas-fir, grand fir/white fir, red fir and subalpine fir.

The grand fir/white fir series is the most extensive, occupying mid-slopes east of the Cascade crest. In eastern Washington, it ranges in elevation from 1800 – 5100' on the Wenatchee National Forest and from 2200 – 4900' on the Colville. It is rare on the Okanogan. In the Blue Mountains of eastern Oregon, it ranges from 2100 – 5900', and in southeast Oregon from 1400 – 5400'.

The Douglas-fir series is less extensive but occurs in a broader elevation range. In eastern Washington, it can be found from 1400 – 5400' on the Wenatchee Forest and in the Methow Valley of the Okanogan, from 2200 – 5400' in the Okanogan Highlands, and from 1900 – 6000' on the Colville. It is fragmented in the Blue Mountains and absent from southeast Oregon.

Both grand fir/white fir and Douglas-fir series can be found on dry to moist sites. On dry sites, the most common early successional tree species is ponderosa pine. At higher elevations, on more moist sites, western larch is the common early successional species, especially on north-facing slopes. Fire suppression during the last century has caused shifts in stand structure, density, and species composition on these sites. Wickman and others (1993) found 75% of these stands are no longer dominated by pine or larch; rather, these stands now consist of large numbers of smaller, climax tree species (i.e. Douglas-fir and other firs). Today, a typical stand in dry or mesic grand fir and Douglas-fir plant associations has a few large overstory pine or larch with a moderately to extremely dense, multi-storied understory of grand fir or Douglas-fir. This has been documented by Hessburg, et. al., in the Interior Columbia Basin Ecosystem Management Project's Eastside Forest Ecosystem Health Assessment, 1994.

The red fir series is found between 5,400 and 7,500 feet elevation from Lake County, California north to Crater Lake. At lower elevations, the red fir series intermingles with white fir series. It can reproduce abundantly after disturbance or under a canopy, and often develops dense, overstocked stands (Eyre, 1980).

The subalpine fir series is found at higher elevations throughout eastern Washington and Oregon (Franklin and Dyrness, 1973; Omernik and Gallant, 1986). It can be found as low as 3000' on north facing slopes in cool valleys, or in avalanche chutes. It is the dominant series above 4800'. Douglas-fir tussock moth can damage these stands, but rarely causes extensive mortality.

Following a major disturbance, reestablishment and development of forest vegetation occurs in stages. For this analysis, Oliver and Larson's 1990 text on stand dynamics was used to categorize the stages. There are four stages: stand initiation, stem exclusion, understory re-initiation, and old growth. The stand initiation stage contains smaller trees that have not fully occupied the available growing space. During stem exclusion, all growing space for trees is occupied and understory trees cannot develop. At understory re-initiation, small gaps in the overstory allow understory trees to develop, creating a multi-storied stand. The old growth stage is reached when, in the absence of major disturbance, all trees that became established after the last major disturbance have died, and trees that developed during understory re-initiation occupy the site.

RISK TO DEFOLIATION AND MORTALITY

Throughout this analysis, there are references to "risk". Research has found that certain stand and site characteristics describe areas most susceptible to a DFTM outbreak and where impacts could be the greatest. Rather than assume the same infestation levels, damage, and mortality would occur across the entire analysis area, and thus overestimate the extent and amount of damage, a set of general hazard/risk rating rules were developed. Appendix K describes these risk rating rules in detail. In general, levels of risk are described as:

High-risk – Dense, multi-storied stands with 60-100% host type trees greater than 9" in diameter. Stands occur on drier south, southeast, or southwest facing mid-elevation slopes and ridges.

Moderate Risk – Single or multi- storied stands with at least 20% host type trees greater than 9" in diameter; any slope aspect at mid- to lower elevations.

Low Risk – Stands of mostly smaller trees (less than 9" in diameter) that have not fully occupied the available growing space; 20% host type; < 40% crown closure; any aspect at high elevations.

High-risk sites are in the stem exclusion, understory re-initiation, or the old growth stage. Moderate-risk sites are in either the understory re-initiation or the stem exclusion stage. Low-risk sites at high elevations can be in any successional stage. Below 4500' in Washington or 8000' in Oregon, low risk sites are in the stand initiation stage.

The nine National Forests where tussock moth outbreak may occur are located in three geographic regions. The Colville, Okanogan, and Wenatchee Forests of eastern

Washington cover the region north of the Yakima River to the Canadian border. The Umatilla, Wallowa-Whitman, Malheur, and Ochoco Forests of eastern Oregon extend from the Washington/Idaho border south to Burns and west to Bend. The Winema and Fremont Forests of southern Oregon cover the area from Fort Rock Valley south to the California border.

There are 5,006,000 acres of National Forest land in eastern Washington. About 20% are 60-100% host type. Host type occurs in both the grand fir and the Douglas-fir series on the Colville and Wenatchee Forests. Host type on the Okanogan is predominantly in the Douglas-fir series. About 84,000 acres are considered at high risk for defoliation. These are multi-storied stands with little remnant pine or larch and many sizes of grand fir or Douglas-fir. Dwarf mistletoe and root disease are common in high-risk Douglas-fir.

There are 6,148,000 acres of National Forest land in eastern Oregon. A little less than one-quarter of these acres are 60-100% host type and of this, 493,000 acres are considered high risk for tussock moth outbreak. The grand fir series dominates but it includes a substantial component of Douglas-fir.

Southern Oregon has 2,200,000 acres of National Forest land. Only a small portion is 60-100% host type, mostly multi-storied stands of true fir and ponderosa pine. Most stands have less than 70% crown closure, and are considered moderate to low risk for defoliation. There is no history of major outbreak (Mason, 1996). Overstocking is common, particularly in the Chiloquin Ridge area and in the southernmost Late Successional Reserve.

The assessment of risk was used to describe existing conditions and to help determine potential effects. Risk was NOT used to prioritize areas or eliminate them from the analysis. It cannot be assumed that DFTM would only occur in the high to moderate risk areas. Table III-1, below, shows the number of acres of host type on each Forest by percent host type and risk category.

In addition to risk from the tussock moth, there is a risk of additional mortality from bark beetles or other forest pathogens. In general, bark beetles are opportunistic and prefer stressed and weakened trees. Douglas-fir beetle, *Dendroctonus pseudotsugae Hopkins*, and the fir engraver, *Scolytus ventralis LeConte* are the major bark beetles of Douglas-fir and true firs, respectively. Stands defoliated by Douglas-fir tussock moth can be killed by defoliation or by bark beetles. The amount of mortality is influenced by defoliation, the environmental conditions preceding and during the outbreak, and bark beetle activity already in the area (Berryman and Wright, 1978; Wickman, 1979). For instance, areas that experienced drought in the previous year or have an ongoing bark beetle outbreak would have higher losses from bark beetles in conjunction with the outbreak than areas where bark beetles were not active. Beetle populations build up in the weakened trees, then attack defoliated and more resistant trees in subsequent years (Berryman and Wright, 1978; Weatherby, et. al 1997). Bark beetle mortality begins during peak years of defoliation and can continue for up to four years after a tussock moth population collapses.

Table III-1: Host Type Acres by Risk

Forest	Host Type	High-risk	Mod.-risk	Low-risk	Total
Colville	60-100%	52,510	87,180	442,560	582,250
	20-60	0	5,880	33,430	39,310
Okanogan	60-100	17,220	101,950	254,450	373,620
	20-60	0	51,270	68,280	119,550
Wenatchee	60-100	14,330	43,330	20,320	77,980
	20-60	0	74,800	23,840	98,640
Umatilla	60-100	270,680	325,500	10,120	606,300
	20-60	10,390	272,020	43,160	325,570
W-W	60-100	188,690	297,610	11,960	498,260
	20-60	54,570	308,000	98,870	461,440
Malheur	60-100	24,170	259,280	53,000	336,450
	20-60	0	172,950	196,670	369,620
Ochoco	60-100	8,850	22,560	10,370	41,780
	20-60	0	43,660	27,260	70,920
Winema	60-100	19,990	29,430	19,610	69,030
	20-60	0	86,660	81,660	168,320
Fremont	60-100	100	770	500	1370
	20-60	0	750	1590	2340
TOTAL		**661,500**	**2,183,600**	**1,397,650**	**4,242,750**

Mortality from defoliation alone is similar for both Douglas-fir and true fir. Douglas-fir suffers higher amounts of overall mortality because it has higher levels of defoliation and because it has a higher secondary mortality from bark beetles. Wickman (1978) found that if a stand contained more than 50% Douglas-fir, the percent of stand mortality more than doubled. In Douglas-fir stands, mortality from defoliation also was concentrated in the smaller trees and mortality from bark beetles in the larger trees. Fir engraver beetles will cause mortality in all size classes of true fir, while Douglas-fir beetles prefer larger dominant and co-dominant trees (12" – 36" dbh). There are a number of areas throughout eastern Washington and Oregon that currently have elevated Douglas-fir beetle populations because of wind throw, fires, and other environmental factors.

COLVILLE NATIONAL FOREST

Douglas-fir beetles have been causing mortality in large Douglas-fir on 1,000 acres per year since 1997. Mortality is concentrated on the east side of the Forest. Fir engraver has also been reported, with noticeable mortality in grand fir on 700 acres per year since 1997. Western balsam beetle caused subalpine fir mortality on 1,200 acres in 1997; damage declined to 200 new acres in 1998. Stands at high risk for DFTM defoliation are mostly on the eastern half of the Forest, particularly the Sullivan Lake and Newport Ranger Districts.

OKANOGAN NATIONAL FOREST

Douglas-fir beetle activity has increased over the last two years. Mapped on 400 acres in 1997, it had spread to over 1,000 acres in 1998. Fir engraver and western balsam bark beetle have caused subalpine fir mortality on 2,000 acres in both 1997 and 1998. High-risk stands are mostly on the Methow Valley Ranger District, along the Twisp River and Eightmile and Granite Creeks.

WENATCHEE NATIONAL FOREST

Douglas-fir beetle has increased over the last two years. It was mapped on 1,000 acres in 1997 and on over 2,500 acres in 1998. Fir engraver has also caused mortality in grand fir: 4,000 acres in 1997, 1,400 acres in 1998. Western balsam bark beetle activity in subalpine fir was mapped at 900 acres each year, in 1997 and 1998. Stands at high risk for defoliation are mostly on the north end of the Forest, along the Entiat River and in the Lake Chelan National Recreation Area.

UMATILLA NATIONAL FOREST

Host type is predominantly grand fir and white fir, but with a substantial Douglas-fir component. Douglas-fir beetle has been increasing on the Forest, with mortality observed on 1,200 acres in 1997 and 4,200 acres in 1998. Fir engraver mortality has recently declines, from 4,700 acres in 1997 to 400 new acres in 1998. Stands at high risk for defoliation are concentrated in the north half of the Forest and around Kelsay Creek, Bowman Spring, and on the Heppner Ranger District.

WALLOWA-WHITMAN NATIONAL FOREST

Host type is predominantly grand fir and white fir, but with a substantial Douglas-fir component. Douglas-fir beetle has been increasing, with mortality of 500 acres in 1997 and 7,300 acres in 1998. In the last two years, fir engraver mortality decreased, with 1,800 acres affected in 1997 and 400 new acres in 1998. A small amount of western balsam beetle mortality in subalpine fir was observed in 1997, but none in 1998. High-risk stands are concentrated in the areas of Horse Ridge, Summit Spring Ridge, along the north end of the Minam River in the Eagle Cap Wilderness, Kuhn Ridge, and Hells Canyon Rim on both sides of the Wilderness boundary.

MALHEUR NATIONAL FOREST

Host type is dominated by grand fir and white fir, but with a substantial component of Douglas-fir. Bark beetles have been active on the Forest in the last two years. Mortality from Douglas-fir beetle was observed over 1,100 acres in 1998. Most of this was in small patches, but one patch was over 500 acres in size. In 1997, fir engraver in grand fir was found in over 1500 acres.

OCHOCO NATIONAL FOREST

Host type stands are mostly grand fir and white fir. Fir engraver beetle populations have been building for the past two years. In 1998, about 3,200 acres were affected. Mortality occurred in a few large patches (one of 1,200 acres). This was an increase over 1997, when several small patches totaled 600 acres. High-risk stands are concentrated in the Bridge Creek Wilderness, the Mill Creek Wilderness, and the Lookout Mt. Management Area.

WINEMA NATIONAL FOREST

Of the 1,000,000 acres on the Winema National Forest, nearly 25% provide host type for tussock moth. These stands are all multi-storied, with trees in all size classes, from seedling to large. In the last two years, bark beetle activity has been noted on the southern half of the Forest.

FREMONT NATIONAL FOREST

Overall, forest health is fair to good. Bark beetles have not been active for the last two years. Only the Demming Creek sub-watershed is included in this analysis.

FOREST ENVIRONMENT

LATE SUCCESSIONAL RESERVES ("LSRS")

LSRs were established in the 1994 Northwest Forest Plan. They are managed to protect and enhance conditions of late successional and old-growth forest ecosystems. These areas serve as habitat for late successional and old-growth related species, such as the northern spotted owl. The reserves are designed to maintain a functioning, interacting, late successional and old-growth ecosystem. The LSR assessments identify vegetation that rovides biological diversity representing the range of natural variability. The general objective of all treatments is to

restore, protect or promote late successional habitat for the northern spotted owl and other late successional species.

Late successional structure stands east of the Cascades have a variety of forest types. These can be dry, open ponderosa pine sites with frequent natural fire return intervals, mesic sites dominated by mixed conifers such as pine, Douglas-fir and grand fir, or moist sites dominated by grand fir, Pacific silver fir and hemlock. Tussock moth host species are an important component of late/old structure on mesic and moist sites. Decades of fire suppression have resulted in these host species also becoming common on dry sites. Multi-storied stands on mesic and dry sites provide habitat and potential habitat for spotted owl and other old growth dependent species.

LSRs east of the Cascades are divided in to three geographic provinces. The Northeastern Cascades Province includes the west side of the Okanogan National Forest and the north half of the Wenatchee. The Yakima Province includes the southern half of the Wenatchee. The Eastern Oregon Cascades includes the Winema National Forest. Each province includes a number of LSRs and is somewhat different from the others ecologically. The provinces and LSRs included are described below.

EASTERN WASHINGTON CASCADES PROVINCE

There are 21 Late Successional Reserves (LSRs) and Managed Late Successional Reserves (MLSRs) in the Eastern Washington Cascades Province, totaling about 767,700 acres (shown in blue on the following table). Four of these are entirely on the Okanogan National Forest. The Sawtooth LSR is on both the Okanogan and Wenatchee Forests. The other 16 are on the Wenatchee.

LSRs on the Okanogan are described in the *1998 Assessment of the Northeastern Cascades Late Successional Reserves*. This Assessment describes LSR vegetation in terms of the biophysical environments in which it occurs. About half of the area is in hot dry, warm dry, or warm mesic biophysical environments. Vegetation in these environments has been strongly influenced by fire suppression. Fire suppression has significantly increased fuels and the risk of stand replacement fire. In much of the area, the biophysical environments are densely stocked with multi-storied Douglas-fir at high risk for tussock moth defoliation. There are host type stands throughout 87% of the LSRs except in cold dry, cold mesic, and cold moist biophysical environments.

Okanogan LSRs provide habitat for 56 known late successional terrestrial wildlife species. Management priorities include protection of late successional habitat, protection of existing late successional and old-growth stands, and enhancement of potential late successional habitat. Special emphasis is placed on existing spotted owl nesting, foraging, and roosting habitat.

LSRs and MLSRs on the Wenatchee are described in the *1997 Forest-Wide Assessment for Late Successional Reserves and Managed Late Successional Areas* and the *1997 Assessments for Late Successional Reserves and Managed Late Successional Areas, Eastern Washington Cascades Province*. These assessments describe LSR vegetation in terms of plant communities with similar fire regimes. Vegetation types are moister on the Wenatchee than the Okanogan. Twenty-seven percent of the LSRs are in the dry forest group. Within this group, dense stocking of grand fir and Douglas-fir is common and susceptibility to tussock moth defoliation is high. Overall, host type occurs over 75% of the LSRs. There is little host type in Hunter Mountain, Slide Peak, Lake Wenatchee, Icicle, Camas, or Twin Lake LSRs. All of the other LSRs contain sufficient host type to support a tussock moth outbreak.

YAKIMA PROVINCE

There are 10 Late Successional Reserves and Managed Late Successional Reserves in the Yakima Province on 158,900 acres (shown in yellow on the following table). All of them are on the Wenatchee National Forest. These LSRs are described in the *1997 Forest-Wide Assessment for Late Successional Reserves and Managed Late Successional Areas* and the *1997 Assessments for Late Successional Reserves and Managed Late Successional Areas, Yakima Province*. There is little tussock moth host type in Bumping, Upper Nile, or Rattlesnake. The other LSRs contain sufficient host type to support a tussock moth outbreak.

EASTERN OREGON CASCADES PROVINCE

There are eight Northwest Forest Plan Late Successional Reserves on the Winema, identified as RO227 through RO324 (shown in orange in the following table). They include approximately 80,000 acres.

LSRs 227, 228 and 229 are described in the *1995 Late Successional Reserve Assessment for #R0227 (eastern half), #R0228, and #R0229 on the Klamath Ranger District, Winema National Forest*. This assessment includes descriptions of vegetative conditions and insect and disease risk. In general, partial cutting and fire suppression have altered the species composition of these LSRs, which now have higher stocking and more white fir than was the case prior to 1900. The assessment emphasizes the need to lessen the risk of catastrophic habitat loss through silvicultural treatments and appropriate protection measures.

The largest LSR is #227, about 61% of LSR acres on the Forest. LSR 227 can be divided into an eastern half, on the Winema National Forest and a western side, on the Rogue River National Forest. The two parts of the LSR straddle the Cascade Crest, and are quite different ecologically. The west side has longer growing seasons, greater precipitation, and longer fire return intervals. Tussock moth exists on the west side, but the risk of outbreak in this type of environment is insignificant. This EIS addresses only the eastern side of the LSR, approximately 49,000 acres in size. There is has tussock moth host type (white fir and Douglas-fir) throughout. Most stands are more than 60% host type. About half of the LSR is late/old structure. Substantial host type is also

found in LSRs 228 and 229, totaling 12,100 acres. The other five LSRs have relatively little host type.

Approximately 100 known or suspected species are associated with these late successional habitats. The northern spotted owl and bald eagle are currently the only federally listed terrestrial species known to occur in the Oregon Eastern Cascades LSRs. These two species are management indicators for old-growth in the Winema Land and Resource Management Plan.

There are 53 spotted owl activity centers on the Klamath Ranger District; 27 are in LSRs and 15 in Wilderness. They are well distributed across multi-storied white fir and Shasta red fir stands. Spotted owl continuity across the Cascade Crest is likely to remain. Habitat in the Lake of the Woods Basin and Sky Lakes Wilderness is stable; large-scale losses from insects, disease, or fire are not expected. The LSRs at risk from mortality from insects and disease are: RO227 (east half) – 29%; RO228 – 12%; and RO229 – 33%.

Table III-2: LSRs in Project Area, in acres

LSR/MLSR	TOTAL ACRES	TOTAL HOST TYPE	HIGH RISK	MODERATE RISK	LOW RISK
Chiwawa	107,162	11,121	1,465	6,059	3,598
Icicle	14,309	24	1	2	21
Lucerne	8,541	3,419	474	2,403	541
Shady Pass	76,253	10,936	2,031	6,043	2,863
Slide Peak	1,658	143	1	71	71
Deadhorse	18,341	5,384	1,043	3,650	690
Hunter Mt.	6,201	1,786	17	1,312	457
Nice	3,130	2,515	148	1,221	1,147
Twisp River	36,396	22,537	1,943	10,784	9,810
Upper Methow	192,052	51,978	4,527	21,793	25,658
Sawtooth (on the Okanogan NF)	51,861	20,321	822	10,676	8,823
Sawtooth (on the Wenatchee)	15,255	293	3	21	269
Little Wenatchee	52,612	36	16	12	8
Boundary Butte	8,753	1,680	24	1,177	480
DM-1	5,581	0	0	0	0
DM-2	1,073	570	23	450	97
DM-3	4,089	951	22	615	314
DM-5	5,271	2,029	303	1,233	493
DM-6	1,546	472	43	342	87
DM-7	9,234	4,308	306	3,431	570
DM-9	15,740	537	51	391	94
Swauk	108,073	29,766	2,137	18,806	8,823
Bumping	15,022	0	0	0	0
Upper Nile	9,209	168	16	75	77
Manastash	104,860	666	63	413	190
Rattlesnake	10,503	796	14	423	358
Teanaway	34,097	28	12	9	7
Tieton	40,084	520	7	238	275
DM-10	24,689	6,426	566	4,463	1,397
DM-11	12,360	2,270	202	1,135	933
DM-12	6,958	2,806	22	2,148	636
DR-14	12,505	0	0	0	0
RO227	49,036	41,873	6,995	21,963	12,915
RO228	2,829	2,251	608	819	824
RO229	9,258	6,974	569	3,605	2,800
RO230	3,014	112	0	50	62
RO231	4,058	3,697	0	1,744	1,953
RO232	7,254	2,614	0	1,181	1,433
RO233	4,311	2,456	0	1,113	1,343
RO234	99	0	0	0	0

OLD-GROWTH/LATE OLD STRUCTURE ("OG/LOS")[9]

From an ecological perspective, "old growth" (OG) describes stands composed entirely of trees that have developed in the absence of any major disturbance such as fire or logging; changes in available growing space have been caused primarily by plant interactions (Oliver and Larson 1990). Stands with younger trees growing upward but still containing some relic trees can be called "transition" old growth. Barring a disturbance, all relic trees eventually die, and the stand consists entirely of trees that grew upward through the deteriorating overstory. These stands are "true" old growth. Using this definition, not all true old growth stands would contain large trees. Forest plans have defined old growth in a variety of ways, but all include some degree of multi-storied structure which includes a component of large overstory trees, large snags, and large down logs. East of the Cascades, these may be open stands dominated by ponderosa pine, or mixed conifer stands dominated by Douglas-fir and true fir. In riparian areas, they may be dominated by Englemann spruce.

During the 1900s, much of the late/old structure eastside forests were logged, with an emphasis on removal of large trees. As a result, the Forest Service has recognized a need to protect remaining late/old forests because of the valuable habitat they provide for many species of plants, animals and fish, and for their value in maintaining high water quality. In 1995, all eastside forests except the Wenatchee were directed to determine the historic range of variability (HRV) of each forest structural stage for any watershed in which a timber sale would be offered ("Eastside Screens"), with particular emphasis on identifying stands having "late/old structure" (LOS), either single- or multi-storied (USDA Forest Service, 1995, "Eastside Screens"). Effects on identified LOS stands are considered with old growth in this analysis.

An important change in many of the OG/LOS forests that remain is the success of fire suppression, which has allowed Douglas-fir and true firs to regenerate abundantly on sites that would otherwise be less densely stocked, with a higher proportion of pine. On some forests, the multi-storied structures that have developed under these conditions are now providing important habitat for old-growth dependent wildlife species. On dry sites, Douglas-fir tends to be susceptible to attack by a variety of insects and diseases, including Douglas-fir tussock moth. These stands provide good habitat for tussock moth, and under outbreak conditions, they are likely to be heavily defoliated. The continuing buildup of natural fuels on these fire-susceptible sites has created conditions where fires burn more intensely and are more difficult to suppress. In this situation, very hot crown fires may result, which can kill overstory trees, taking these late/old forests back to an early successional stage. (Refer to the Fire section of this chapter for a more complete discussion of fuel buildup and fire risk.) Stands identified as "high risk" with dense crown closure have the highest likelihood of damage if a tussock moth outbreak occurs.

Eastern Washington

About half of the late/old structure in the eastern Washington Forests is tussock moth host type.

COLVILLE NATIONAL FOREST

There are 175,800 acres of late/old structure on the Colville. Most of this is on the west side of the Forest or in the Salmo-Priest Wilderness near the Canada/Idaho border.

OKANOGAN NATIONAL FOREST

There are 184,300 acres of late/old forest on the Okanogan. Most of this is on the north half of the Forest, particularly the upper Methow Valley.

WENATCHEE NATIONAL FOREST

There are 515,100 acres of late/old structure on the Wenatchee National Forest. Most of these acres are not in tussock moth host type. Late/old structures in host type are found mainly in the Late Successional Reserves where they are an important habitat component for spotted owl.

Eastern Oregon

Three quarters of LOS in northeastern Oregon is tussock moth host type.

UMATILLA NATIONAL FOREST

There are over 300,000 acres of late/old structure on the Umatilla. These are scattered, relatively small stands. The largest single stand of old structure is 1,300 acres of host type in the Wenaha-Tucannon Wilderness.

WALLOWA-WHITMAN NATIONAL FOREST

There are 496,000 acres of late/old structure on the Wallowa-Whitman, about one-fifth of the Forest's total land. Most of these acres are in host type. There are some non-host stands in the Eagle Cap Wilderness and near the Powder River.

There are late/old stands throughout the Forest. The only extensive areas on the Wallowa-Whitman where late/old stands are absent are along the Snake River and at high elevations near Eagle Cap. Concentrations of high-risk host type are found along the Minam River in the Eagle Cap Wilderness, Powatka Ridge, and Broady Creek on the northern boundary of Hells Canyon NRA, Big Sheep Creek, Indian Rock, and on the adjacent Nez Pierce National Forest along the Salmon River. Patches of high-risk LOS are found throughout Hells Canyon NRA and the Pine Ranger District. About 21,000 acres on the Pine District received light to moderate defoliation from tussock moth in 1999.

MALHEUR NATIONAL FOREST

There are 275,500 acres of late/old forest on the Malheur. This is about 20% of the Forest's total land. Most of this

[9] Please see Appendix L for more information on OG/LOS.

structure is in host type. A number of these stands provide unique habitat. These include a remnant stand of Alaska yellow cedar that is surrounded by host type, the Canyon City watershed, the visual corridor along Indian Creek trailhead, Upper Deer Creek watershed, Magone Lake, Vinegar Creek, John Day and Middle Fork John Day headwaters, the Genesis Project Area, Reynolds, Phink/Elk and Wickiup watersheds.

OCHOCO NATIONAL FOREST

There are 83,700 acres of late/old forest on the Ochoco. Most of the late/old structure is on the north half of the forest, and is 60-100% host type. Old structures on the south half (Snow Mountain District) are mostly non-host.

Southern Oregon

One-third of the late/old structure on southeastern Oregon Forests is tussock moth host type. Most of this (238,200 acres) is on the Winema.

WINEMA NATIONAL FOREST

There are 238,200 acres of LOS on the Winema. About 37,400 acres (15%) have 60-100% host type stands, all on the Klamath Ranger District. About 54,200 acres (25%) are mixed stands with a substantial Douglas-fir or true fir component; these are primarily on the Chiloquin Ranger District. The remaining stands dominated mostly by ponderosa pine, with Douglas-fir or true fir as a minor component.

FREMONT NATIONAL FOREST

There are 62,100 acres of late/old structure on the Fremont, and all are dominated by ponderosa pine.

FIRE

OVERVIEW

Fire is a major disturbance that produces vegetation changes in ecosystems. It has been present in the coniferous forests of eastern Washington and Oregon for centuries (Agee, 1993 and 1994). Fire is probably responsible for the distribution, composition, structure, and health of the ponderosa pine, Douglas-fir, and true fir plant communities. Historically, fire maintained ponderosa pine throughout its range at lower elevations and killed invading Douglas-fir and true firs (Spurr and Barnes, 1980). Many ecosystems were maintained by fire; life for many forest species literally begins and ends with fire. Management policies that exclude fire lead to changes in forest species succession and disturbance processes. Fire exclusion has created more severe disturbance regimes than those to which native plant and animal species are adapted. Current fire regimes are generally less frequent but with more severe effects than fires in natural ecosystems.

Changes in vegetation type, structure, and composition have had a profound effect on fire regimes in forested areas over the past 100 years (Hann, et. al., 1997). Some of the more significant changes include:

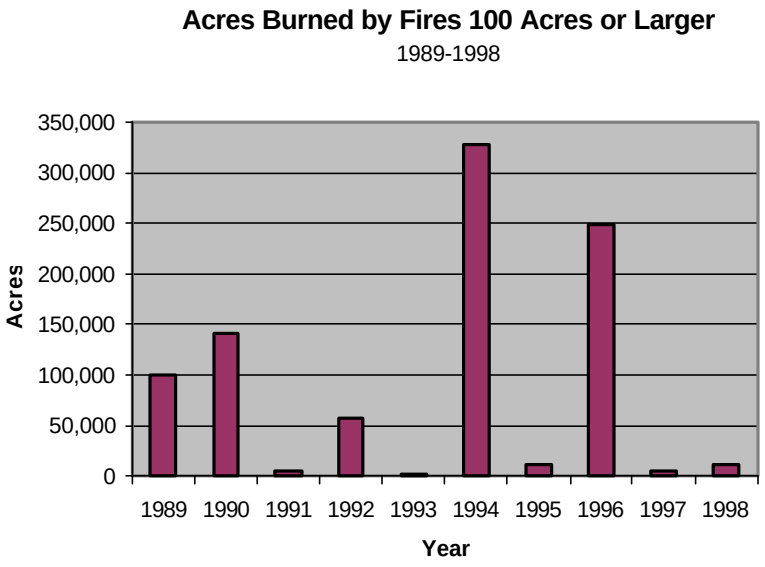
- declines in area and increasing fragmentation of pine forests
- an increase in shade-tolerant, climax fir forests
- more homogeneous forest composition and stand type (Quigley and others, 1996).

Agee (1993) studied wildfires in Pacific Northwest forests from 1916 through 1992 and concluded that size and extent was correlated to the advancement of fire suppression technology and fuel accumulations. In the early 1900s, fire intervals were generally synchronized with fuel accumulations. Since then, the volume of fuel has steadily increased because of suppression efforts and a subsequent decline in fire frequency. As a result, fire size, fire intensity, and fire severity have all increased, as have suppression costs and the associated hazards to life and property. The average costs of wildfire suppression, number of firefighter fatalities, and size of high-intensity fires during the last 25 years are double the corresponding levels that occurred between 1910 and 1970 (Hann, et. al., 1997).

Wildfire-suppression activities, aided by improved technology for fire detection, prevention, and suppression, successfully reduced the size of most wildfires from 1910 to 1970 (Hann, et al., 1997). Recently, the area burned by wildfires has increased, even though land managers have allocated more resources to wildfire suppression. The current size of wildfires is now approaching that experienced in the early 1900s. Further complicating wildland fire management is that the human population in wildland areas has increased substantially in the last few decades. Unfortunately, the most popular areas are often associated with the highest fire danger. Resultant concerns include simultaneously providing for the safety of people, protection of homes, firefighter safety, and the cost of fire suppression. Fires that impacted both natural resources and populations include the 1994 Tyee Creek Fire in eastern Washington (140,000 acres) and the 1990 Pine Springs Basin Fire in south-central Oregon (73,000 acres). The chart below illustrates the large, but variable extent of wildfire in eastern Washington and Oregon over the last ten-years.

Only recently has fire policy been modified to recognize the importance of fire as an ecological process that has an important role in the management and restoration of ecosystems. The 1995 USDI and USDA *Federal Wildland Fire Management Policy and Program Review* recommended a set of consistent policies for all federal wildland fire management agencies. It recognized that wildfire has historically been a major process maintaining healthy wildlands and that it must be allowed to continue this natural role wherever possible. The report also recognized that not all agencies would employ all identified procedures on all administrative units at all times (USDI and USDA, 1996).

The severe wildfire seasons in northern California and southwest Oregon in 1987, in Yellowstone Park and the



northern Rocky Mountains in 1988, and throughout much of the west in 1994 and 1996, made it clear that fire cannot be effectively excluded from fire-dependent ecosystems. Conversely, because of development in the wildland/urban interface, commercial forests, and widespread fuel accumulations, fire cannot be fully restored to its historic role.

Fire Frequency and Severity

Fires can be described by their effects on vegetation and how often these effects occur. Severity refers to the amount of damage a fire actually causes; the return interval refers to how often a particular type of fire occurs. There are 4 severity classes and 5 interval classes (Agee, 1993):

1. Lethal (kills the dominant layer of plants)
2. Mixed (mixed effects)
3. Non-lethal (does not kill the dominant layer of plants)
4. Rarely burns

A. Very frequent interval (0 - 25 years)
B. Frequent (26 - 75 years)
C. Infrequent (76 - 150 years)
D. Very infrequent (151 - 300 years)
E. Extremely infrequent (> 300 years)

Non-Lethal Fires kill 10% or less of the dominant tree canopy. A much larger percentage of small understory trees, shrubs, and forbs may be burned back to the ground line. These are commonly low severity surface and understory fires, often with very frequent return intervals.

Mixed Severity Fires kill 10 - 90% of the dominant tree canopy. These fires are commonly patchy, irregular burns, producing a mosaic of different burn severities. Return intervals are variable.

Lethal Fires kill 90% or more of the dominant tree canopy. These are often called stand-replacing fires and they often burn with high severity. They are commonly crown fires. In general, lethal fires have long very infrequent return intervals but affect large areas.

Historically, eastern Washington and Oregon had a variable fire regime of long-interval, large, lethal fires mixed with shorter-interval, non-lethal, and mixed severity fires. There is little similarity, however, between historical and current succession/disturbance regimes on forested lands in these states. With few exceptions, disturbance frequency declines as disturbance severity increases. Recent changes in vegetation composition and structure of forests and rangelands have substantially increased the risks of wildland fires at both the landscape and regional levels. These changes to western warm dry forests have been well documented. With effective exclusion of under-burning in this century, warm dry forests have become over-stocked, often exceeding carrying capacity. In the absence of fire, native insects and pathogens play a more active role in regulating stocking. Previously, frequent under-burning prevented excess accumulation of carbon and nutrients in woody biomass. The natural balance between fire and biological decomposition in regulating carbon accumulations has been disrupted. The danger of stand-replacing wildfire is that fuel accumulations get so high that fires are extremely hot. The result can be a critical reduction of stored nutrients and loss of potential site productivity. Effective fire prevention and suppression activities have led to increased ground fuel accumulations and stratified fuels (both living and dead) to the point where fires became more difficult to contain or confine. These fires burn hotter and more extensively than they did in the past. This affect has been especially evident in dry forests that historically burned frequently (Harvey, 1994).

In the past 100 years, fires have become less frequent and more intense (Agee, 1993; Gast, et. al., 1991 in Lehmkuhl, et. al., 1994). In forestlands, fire severity has shifted substantially from non-lethal to lethal between the historical and recent past on Forest Service and BLM-administered lands (Quigley and others, 1996).

Lack of frequent, non-lethal underburns has resulted in:

- an increase in fuel loading,
- an increase in duff depth (up to 6B24 inches under old trees)
- an increase in stand density (generally development of dense conifer understories beneath old stands and thickets of small trees where the overstory has been removed)
- a fuel ladder that can carry fire from the surface into the tree crowns.

In general, the exclusion of fire and extensive harvesting of large, shade-intolerant trees has resulted in a shift of forest dominance to smaller, shade-tolerant trees that are more susceptible to stress, insects, and diseases.

In dry forest types, stand structures have changed from open park-like stands of large trees with clumps of small trees, to dense overstocked young stands with several canopy layers (Caraher, et al., 1992; Gast, et. al., 1991). The interval between fires has doubled or tripled to 40 to 80 years. Increasing the intervals without corresponding fuel reductions has resulted in much higher fuel loads and much higher fire intensities than were previously experienced. In general, the natural fire regime of the dry forest types consisted of approximately 80% non-lethal underburning fires, 5% mixed fires, and 15% crown fires. Crown fires tended to occur most frequently on steeper slopes. Current fire regimes within the dry forest types comprise 20% lethal crown fires, 35% mixed fires, and 45% non-lethal underburns (Hann, et al., 1997). With the exclusion of fire, stand densities has increased and species composition has changed to dominance by DFTM host types (i.e., Douglas-fir, grand fir, and white fir). The younger forest structure and multi-storied structure of more shade-tolerant species is highly susceptible to large-scale infestations of insects and disease. The increasing number of small dead trees in stands attacked by insects and diseases makes forests even more susceptible to large high-intensity fires. The stands most susceptible to moisture stress, insects, and disease tend to be those at the lowest elevations, often bordering private homes and other property (Everett, et. al., 1994).

Moist forests tend to be located in an environment that rapidly produces biomass and accumulates fuels. Forest succession, an increase in lethal stand-replacing fires, and an increase in human disturbances have changed the structure and composition of vegetation within moist forests. Because fires in moist forests were less common than in dry forests, the effects of fire exclusion on forest structure and composition are not as obvious in moist forests. Major changes to the moist forest potential vegetation group include increased stand density and increased dominance by even-aged shade-tolerant species. Landscapes are now dominated by shade-tolerant species, or a mixture of shade-tolerant and intolerant species, particularly in areas that have been harvested and fire suppression has been successful. The effective exclusion of almost all non-lethal underburns and a reduction of mixed fires have resulted in the development of dense multi-storied stands with high potential for stand-replacing fires. These highly productive forests have increased amounts of carbon and nutrients stored in woody material, resulting in fires that are of higher intensity and severity. Even where fires do not crown, dominant trees can be killed by consumption of large diameter surface fuels and duff layers. Potential for high amounts of soil heating and death of tree roots and other understory plants is much higher than it was historically. The current fire regime has become very simplified compared to the historical regime. Because of higher fuel loads, increased stocking levels of trees, and high late summer moisture stress levels, most of moist forest types shifted to lethal crown fire or mixed fire regimes. In contrast with warm, dry forests, biological decomposition in warm moist forests is substantial and the role of fire in nutrient cycling is reduced. Conversion of tall, well-spaced pine stands to low densely stratified Douglas-fir and true fir stands results in hazardous fuel ladders.

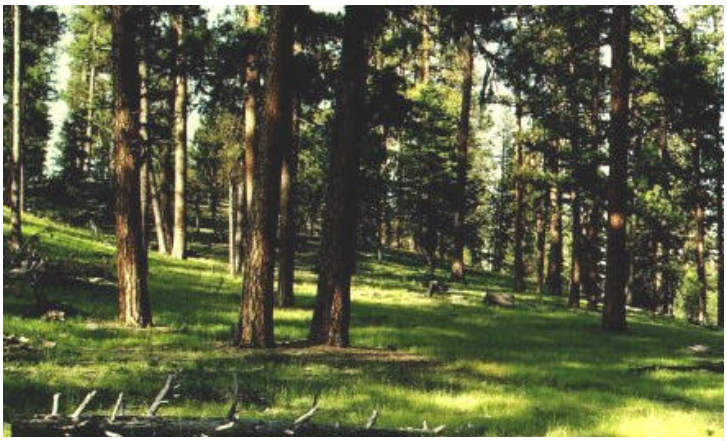


Figure III-1: Open park-like appearance of non-host stand

Transition forests (warm, dry to warm, moist) possess most of the features of both dry and moist forests. Landscapes were historically a complex patchwork of stands that resulted from lethal and non-lethal fires. Due primarily to the influences of fire exclusion and selective logging, modern day forests are far more homogenous than historical forests. Loss of landscape diversity is primarily associated with increasing dominance and layering of shade-tolerant species in stands previously dominated by open-growing ponderosa pine or other seral species. On areas that transition to moist forest types, the historic forest species composition was mixed with pine and larch playing a more dominant role than that of today. Due to the changes discussed in the previous paragraphs, mixed severity fires are now an improbable occurrence in many transition forests (Harvey, et. al., 1995; USDA 1999).

With large fuel accumulations and dense stocking, levels of root disease and other pathogens can be substantial and increasing accumulations of dead Douglas-fir and true fir associated may be expected. Additionally, conversion of tall well-spaced trees to shorter, denser fir stands results in hazardous fuel ladders. Thus, significant changes in fire behavior are also a characteristic of modern day, moist interior forests. Such changes in fire behavior threaten fire control and place neighboring forest ecosystems at risk (Harvey, 1994).

AIR QUALITY

Wildfires currently have a significant impact on the air resource, degrading ambient air quality and impairing visibility. The wildfire regime is significantly different than it was historically. Fire suppression activities have resulted in altered fire regimes; the area burned in non-lethal understory burns is only one-third of that which burned historically. The results of fire exclusion include increased fuel loading, development of ladder fuels, and increases in stand density, each of which increases the

potential for large, lethal, stand-replacing wildfires such as those experienced in recent years. Stand-replacing fires consume much more fuel and produce much more smoke than non-lethal fires, which usually burn with low surface fire intensities in the understory. Brown and Bradshaw (1994 cited in USDA and USDI, 2000) found that emissions were greater from current fires, even though they burned fewer total acres than historically, because consumption of fuel per unit area burned has been greater in the current period.

Prescribed fires are used to reduce the amount of carrier fuels and ladder fuels, and thus the potential for lethal, stand-replacing fire. The fires are ignited under fuel moisture conditions that reduce total fuel consumption, and when mixing height and winds are most favorable for smoke dispersal away from populated areas.

While increased levels of prescribed fire can have temporary negative impacts on air quality, long-term impacts to air quality from wildfires can be reduced (Schaaf, 1996). Over the past ten years, State air regulators and scientists have that smoke pollution commonly lasts several days. For example, the 1994 wildfires around Wenatchee, WA, produced 24-hour concentrations of smoke that was more than double federal health standards; the condition persisted for several days. Impacts to populated areas from prescribed fires can be more frequent, but the level of impact is well below established health standards (Scire and Tino, 1996 cited in USDA and USDI, 2000).

TIMBER MANAGEMENT

The Forest Plans for the nine Forests considered in this document allocate "management areas" to meet objectives such as "scenic", "motorized or non-motorized recreation", "general forest", etc. Each management area specifies whether planned timber harvest is allowed.

In addition, plans on eight Forests -Colville, Okanogan, Umatilla, Wallowa Whitman, Malheur, Ochoco, Winema, and Fremont (the Wenatchee is excluded)- have been amended by the *Decision Notice for the Revised Continuation of Interim Management Direction Establishing Riparian, Ecosystem, and Wildlife Standards for Timber Sales*; commonly known as the ***"Eastside Screens"*** (USDA Forest Service, 1995, "Eastside Screens"). These "screens" have changed the objectives for most timber sales, which, in turn has resulted in a significant reduction in the available volume per acre. For example, timber harvest is not allowed in riparian areas. Timber sales in watersheds that do not currently meet historic levels of "late and old structural characteristics" (LOS) must be designed to develop additional LOS in the area. In watersheds that meet historic LOS levels, timber harvests must maintain LOS within those historic levels.

In similar fashion, Forest Plans on three Forests (the Okanogan NF, Wenatchee, and Winema National Forests) have been amended by the *Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents In the Range of the Northern Spotted Owl*; commonly known as the "*Northwest Forest Plan*"(USDA Forest Service, 1994). As with the Eastside Screens, this plan has significantly changed areas from which timber can be harvested as well as the available volume per acre in those areas where harvest is allowed.

Table III-3 displays all acres in host type with commercial size timber (>9" dbh) in Forest Plan land allocations that allow timber harvest. This includes all areas available for harvest in stand sizes of small (9"-14" dbh), medium (14"-21" dbh), and large (>21" dbh) timber. By using a series of continuous inventory plots placed in grid fashion over all National Forests, the Forest Service estimated commercial volume in host type for tree species defoliated by the Douglas-fir tussock moth.

Table III-4 shows volume available for harvest by Forest; volume was calculated on commercial timber 9" or larger.

Table III-3: Acres in Host Type Available for Harvest

FOREST	20-60% HOST TYPE	60-100% HOST TYPE	TOTAL
Colville	33,430	466,780	500,210
Okanogan	45,040	206,660	251,700
Wenatchee	64,050	49,470	113,520
Umatilla	138,810	229,970	368,780
W-W	214,620	250,040	464,660
Malheur	312,300	257,460	569,760
Ochoco	2,810	69,920	72,730
Winema	116,740	11,370	128,110
Fremont*[10]	1,910	760	2,670
Total	**929,729**	**1,542,489**	**2,472,218**

Table III-4: Volume in Host Type Available for Harvest, in thousands of board feet (mbf)

FOREST	20-60% HOST TYPE	60-100% HOST TYPE	TOTAL
Colville	27,700	963,100	990,800
Okanogan	32,600	329,200	361,800
Wenatchee	78,000	132,400	210,400
Umatilla	150,900	661,300	812,200
W-W	232,500	543,300	775,800
Malheur	301,400	563,800	865,200
Ochoco	6,800	377,600	384,400
Winema	108,800	21,200	130,000
Fremont	300	2,200	2,500
Total	**939,019**	**3,594,159**	**4,533,178**

[10] Demming Creek watershed only

SEED ORCHARDS

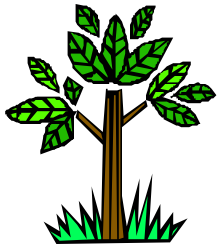
All National Forests in the Pacific Northwest have orchards to provide seed for reforestation. Orchard trees were grown from open-pollinated seed collected from parent trees that are considered superior in terms of vigor, form, or resistance to local disease. Seedlings from these parent trees show good juvenile survival. Orchards represent considerable investment, including removal of stumps and large rocks, fencing, weed control, and monitoring, and replacement of select trees.

There are 16 orchards in the analysis area that are partially or entirely Douglas-fir:

Colville National Forest: Cedar Creek, Teepee, Brown Mountain, Palmore, Gletty

Okanogan National Forest: Polepick, Peony

Wallowa-Whitman National Forest: Kuhn Ridge, Frog Heaven, Paddy Flat, Forshey, Black Mountain, Yellow Pine



Umatilla National Forest: Mallory, Dugout, Fry

AREAS CURRENTLY PROTECTED FROM BARK BEETLES

In general, bark beetles prefer stressed and weakened trees. When a disturbance, such as a fire or windstorm occurs, the beetles attack damaged trees and produce high numbers of offspring. Subsequent generations attack and kill healthy trees as the supply of stressed trees diminishes. Old-growth stands are highly susceptible to Douglas-fir bark beetle outbreaks because the large, slow-growing trees are often already under stress from competition with other trees and vegetation.

Over the past several years, a number of forest fires and storms have created conditions conducive to a Douglas-fir bark beetle epidemic in parts of the Region. Treatments to minimize impacts on resources have included salvage and removal of infested trees, thinning, and the use of anti-aggregating pheromones and pheromone baits. The primary objective has been to protect existing old-growth, threatened and endangered species habitat, and recreation sites. If a Douglas-fir tussock moth outbreak occurred, the defoliation could result in the tree mortality that the bark beetle projects were attempting to prevent.

The table below identifies areas in which investments have been made to manage, treat, or prevent mortality from Douglas-fir bark beetle within the Douglas-fir tussock moth analyses areas:

WATER QUALITY

Substantial areas of eastern Washington and Oregon are subject to defoliation by Douglas-fir tussock moth. The magnitude and distribution of the defoliation would undoubtedly be varied, producing a mosaic of vegetative canopy conditions. During outbreaks in the 1970s, defoliation patterns ranged from partial and small patches to large tracts of 1000 acres.

Water quality concerns associated with defoliation can be grouped into two broad categories: 1) Potential effects that could affect whether water bodies meet State water quality standards and can provide for identified beneficial uses, and 2) Effects on water bodies that do not currently meet State standards. The following table provides a summary of total miles of streams and a summary of stream miles in areas where Douglas-fir tussock moth host type exceeds 60% stand composition. These stands could experience significant (if not total) defoliation and mortality if a DFTM outbreak occurred.

In accordance with *Section 303(d)* of the federal *Clean Water Act*, States must maintain a list of stream segments that do not meet water quality standards. Numerous stream segments in eastern Washington and Oregon are currently listed as *water quality limited*. This means they do not meet State water quality standards for specific water quality criteria. Table III-7 summarizes water quality criteria linked to current *303(d)* listings on each National Forest in the project area that could be affected by defoliation. Six additional criteria are not considered to be substantially or significantly at risk of change as the result of defoliation (State of Oregon DEQ; State of Washington DOE, 1998). Not all water bodies are listed for all variables. Refer to State agency records to identify which particular water bodies are listed for which criteria. The following websites provide a description of the *303(d)* process, variables of concern, and the actual listings each stream:

WA: http://www.wa.gov/ecology/wq/303d/;

OR: http://waterquality.deq.state.or.us/wq/303dlist/.

Table III-5: Areas Currently Being Treated for Bark Beetles

Forest	Area	Acres	Values being protected
Wenatchee	North 25 Mile Fire	~3,250 acres	Old-growth, and spotted owl habitat in/adjacent to the fire area
Wallowa-Whitman	Pine Creek Watershed	~ 350 acres	Bull trout habitat, old-growth
	Hells Canyon NRA	~ 42 acres	Bull trout habitat, old-growth, campgrounds
	Oregon Trail Interpretive Area	~ 400 acres	Historical Site, old-growth, high use recreation
Malheur	Banner Blowdown	~3,600 acres	Bull trout habitat, old-growth

Table III-6: Miles of Stream in 60-100% Host Type

Forest	Total Miles	Total Miles in Host Type
Colville	1956	1,155
Okanogan	3106	766
Wenatchee	4634	168
Umatilla	2698	1,438
W-W	4678	1,283
Malheur	2930	816
Ochoco	1605	86
Winema	927	80
Fremont	2031	4
Total Miles of Stream	**24,565**	
Total Miles in Host Type		**5796**

Table III-8, below, summarizes information relative to the potential for affecting stream temperature, sediment levels, or NH3. Generally, streams with current water quality concerns and that flow through host types susceptible to significant defoliation are of higher concern than other areas or stream segments. It is important to note that stream segments that are state listed are **not** necessarily impaired along the whole length of the stream or stream segments. The table is only an indication that one or more portions of the stream has not met one of the water quality standards. The miles of stream shown as being listed as water quality impaired (*303(d)*) are inclusive; that is these miles include both stream segments that are listed in stands of greater than 60% host type and stream segments that are listed in stands of greater than 60% host type. For example, there are a total of 6 miles of stream segments on the Colville NF listed as impaired because of stream temperature. Of these 6 miles, about two are in an area of greater than 60% host type.

Forest	Impairment Criteria		
	Temperature	Sediment	Nitrogen
Colville	X		X
Okanogan	X		
Wenatchee	X		X
Umatilla	X	X	X
W-W	X	X	
Malheur	X		
Ochoco	X	X	
Winema	X	X	
Fremont	X		

Of all the criteria, temperature is probably the most relevant to this analysis. Temperature "standards" are flexible; there is no specific temperature for each stream or river. The goal of the criteria is to protect fish and aquatic life. It is based on scientific analysis of the needs of cold-water aquatic species. The standard sets the criterion at 64° in Oregon unless there is cold-water fish spawning or bull trout habitat; temperature requirements for these species are 55° and 50°, respectively. In the summer, some streams have probably always exceeded the maximum allowable temperature. The number of such streams is unknown. The standard recognizes that not all streams will be able to comply for this reason. In addition, some stream segments on *303d* lists may have been improperly listed and could actually have relatively cold waters.

Table III-7: Summary of Water Quality Criteria

Table III-8: Impaired Streams

Forest	Temperature		Sediment		Nitrogen	
	303(d) Miles	*303(d)* Miles in >60% Host Type	*303(d)* Miles	*303(d)* Miles in >60% Host Type	*303(d)* Miles	*303(d)* Miles in >60% Host Type
Colville	6	2	0	0	4	1
Okanogan	24	4	0	0	0	0
Wenatchee	197	21	0	0	64	2
Umatilla	446	208	37	25	8	6
W-W	767	141	229	37	0	0
Malheur	501	182	0	0	0	0
Ochoco	440	27	23	2	0	0
Winema	111	16	12	4	0	0
Fremont	354	2	0	0	0	0
TotalMiles of Impaired Stream	3,149		301		76	
Total Miles of Stream in Host Type		603		371.6		9

FISH & WILDLIFE

The habitats assessed in this analysis consists of Douglas-fir/white fir, grand fir, and subalpine fir forests on dryer sites at elevations generally from 1500 to 6000 feet in Washington and 2000 to 8000 feet in Oregon. Areas at highest risk of a tussock moth outbreak are lower elevation, multi-storied, Douglas fir, white fir, and grand fir forests with at least 9" diameter trees and more than 40% canopy closure. Subalpine fir forests may experience tussock moth activity, but extensive mortality is not expected to occur.

Many species of wildlife are associated with these habitats on the nine Forests. Federally listed species, sensitive species, management indicator species, and species about which concerns were raised from comment of the Draft Environmental Impact Statement were evaluated. Those included resident and anadromous fish, Larch Mountain salamander, Oregon and Columbia spotted frog, eleven bat species, elk, deer, grizzly bear, gray wolf, goshawk, bald eagle, peregrine falcon, spotted owl, several woodpeckers, four grouse, and 80 - 100 migrant and resident songbirds.

THREATENED & ENDANGERED SPECIES

Table III-9 lists the Federally-listed Threatened and Endangered Species considered in this analysis.

Anadromous Fish

Five DFTM-project Forests have one or more of the following species of anadromous fish: steelhead trout (*Oncorhynchus mykiss*), chinook salmon (*Oncorhynchus tshawytscha*), sockeye salmon (*Oncorhynchus nerka*), and chum salmon (*Oncorhynchus keta*).

Steelhead are a sea-going ("anadromous") form of rainbow trout. Upper Columbia River steelhead trout are found on the Wenatchee and Okanogan National Forests. It is listed as federally endangered. Mid-Columbia River steelhead occur on the Wenatchee, Umatilla, Malheur, and Ochoco Forests. Snake River steelhead trout live on the Umatilla and Wallowa-Whitman Forests. All are listed as federally threatened.

There are several populations of chinook salmon on Forests within the analysis areas. Upper Columbia River spring chinook salmon occur on the Okanogan and Wenatchee National Forests; they are listed as federally endangered. On the Umatilla and Wallowa-Whitman Forests, Snake River spring/summer and fall chinook populations are listed as federally threatened.

Table III-9: Federally Listed Species[11]

	COL	OKA	WEN	UMA	W-W	MAL	OCH	WIN	FRE
ENDANGERED SPECIES									
Upper Columbia Steelhead Trout		D	D						
Upper Columbia Spring Chinook Salmon		D	D						
Snake River Sockeye Salmon					D				
Lost River Sucker								D	
Shortnose Sucker								D	D
Gray Wolf	D	D	D						
Woodland Caribou	D								
THREATENED SPECIES									
Mid Columbia Steelhead			D	D	I	D	D		
Snake River Steelhead Trout				D	D				
Snake River Spring/Summer Chinook				D	D				
Snake River Fall Chinook				D	D				
Columbia Chum Salmon				I	I	I			
Columbia River Bull Trout	D	D	D	D	D	D	D		
Klamath River Bull Trout								D	D
Warner Sucker									I
Northern Bald Eagle	D	D	D	D	D	D	D	D	D
Northern Spotted Owl		D	D					D	
Grizzly Bear	D	D	D						
Canada Lynx	D	D	D	D	D	D	S	S	

[11] **D = Documented Occurrence, S = Suspected Occurrence, I = Influenced by USFS Actions Upstream**

Sockeye salmon occur in two forms: the anadromous *sockeye* salmon, and the non-anadromous *kokanee*. The only listed population in the analysis area is the Snake River Basin sockeye salmon, on the Wallowa-Whitman National Forest. Populations on the Okanogan and Wenatchee Forests are not on the Endangered Species List.

Chum species have the widest natural geographic and spawning distribution of any Pacific salmonid but do not occur in the analysis area. However, the Umatilla, Wallowa-Whitman, and Malheur Forests contain streams that flow into chum habitat in the Columbia River; activities on these Forests have the potential to affect downstream populations.

All anadromous fish require cool water for some or all of their life stages. Unsuitable temperatures can lead to disease outbreaks in migrating and spawning fish, altered timing of migration, and accelerated or retarded maturation. Most stocks evolved with the temperature patterns of the streams they use for migration and spawning. Deviation from normal patterns could adversely affect survival. Factors that influence stream temperature include air temperature, daily average solar isolation, air velocity, relative humidity, stream depth, ground water inflow, and the extent to which riparian vegetation and topography shade the stream (Adams and Sullivan 1990). The stream temperature at any location in a watershed at a given air temperature is dependent on the relative importance of each environmental condition at the site. Small headwaters streams tend to be cool in summer despite hot weather, due to ground water inflow and riparian shading. In large, wide rivers, neither ground water inflow nor riparian shading is as important due to stream width and total water volume. Even under natural conditions, water temperatures increase with increasing distance from the headwater source. As water moves downstream, stream temperatures become increasingly more influenced by local conditions. Channel morphology can be a significant factor - as width increases and depth decreases, a stream becomes more susceptible to air temperature heating. Removal of riparian vegetation can also result in an increased temperature at the site. Canopy openings from multiple disturbances could increase stream temperature if there was continuous exposure, if the stream widened and/or became shallower, or if water was withdrawn (Adams and Sullivan, 1990).

In spawning areas, the amount and suitability of stream substrate and flows is also critical. Adequate flows of well-oxygenated water and small amounts of fine sediments allow a high percentage of young fish to survive (Meehan, 1991). Flows determine the amount of spawning habitat available by regulating the area covered by water and the velocities and depths of water over the gravel beds. Stream flows can also affect adult migration to spawning areas.

The following describes the current condition of listed anadromous fish within the project area as it relates to the potential for a Douglas-fir tussock moth outbreak. Only host type within 300' of occupied anadromous fish streams was evaluated. Emphasis was placed on stream segments that are *303d*-listed for elevated stream temperature.

OKANOGAN AND WENATCHEE NATIONAL FORESTS

The Okanogan and Wenatchee National Forests are within the Upper Columbia River Inland Steelhead Ecologically Significant Unit ("ESU"); it includes the Wenatchee, Entiat, Methow, and Okanogan River Basins (Busby et al. 1996). On the Wenatchee Forest, "depressed" populations of steelhead are located in the Entiat and Wenatchee River drainages. Other drainages on the Forest are suspected to have steelhead, but reliable information is not available (Quigley et al. 1997). The Okanogan National Forest has depressed populations of steelhead in the Twisp and Chewuch River drainages, tributaries of the Methow River. This Upper Columbia steelhead ESU is in danger of extinction due to with genetic homogenization from hatchery supplementation, apparent high harvest rates of steelhead smolts in rainbow trout fisheries, and the degradation of freshwater habitats, especially the effects of grazing, irrigation diversions, and hydroelectric dams (Busby, et al., 1996). Steelhead on these Forests are federally endangered.

Both Forests are also part of the Upper Columbia River Spring, Summer, and Fall Run Chinook Salmon ESU. The spring run ESU consists of Federally Endangered stream-type chinook salmon that spawn above Rock Island dam, in the Wenatchee, Entiat, and Methow Rivers. Their population has declined in the Methow River drainage. The summer/fall run ESU includes Federally Endangered ocean-type chinook salmon that spawn between McNary and Chief Joseph Dams. On the Wenatchee Forest, there are depressed populations of ocean-type chinook salmon along the lower reaches of the Entiat River, but improving populations in the lower reaches of the Wenatchee. There are also includes declining populations of stream-type chinook in the Naches River, upper reaches of the Yakima River, and upper reaches of the Wenatchee and its tributaries (Chiwawa River, White River, and Little Wenatchee River). Ocean-type chinook salmon do not spawn on the Okanogan National Forest. Unlike the spring run, this summer/fall ESU is not currently in immediate danger of extinction (Myers, et. al., 1998).

Sockeye populations on/near the Wenatchee Forest are part of the Lake Wenatchee ESU. This ESU includes all sockeye that spawn above or in Lake Wenatchee and rear in Lake Wenatchee (Gustafson, et. al., 1997) and sockeye in the Chelan and Wenatchee River drainages. There is a population of landlocked sockeye ("kokanee") salmon in the Naches River drainage. Sockeye salmon that live and spawn in the Methow and Entiat Rivers originated from transplants (Gustafson et al. 1997). Therefore, these populations are not considered part of an evolutionary significant unit.

There are approximately 150 linear miles of occupied anadromous fish streams on the Wenatchee and Okanogan Forests bordered by host type.

UMATILLA AND WALLOWA-WHITMAN FORESTS

Both Forests are in two steelhead ESUs: the Mid-Columbia River and the Snake River Basin. Generally, the southern portion of each Forest is in the Mid-Columbia River ESU and the northern portion is in the Snake River Basin ESU. On the Umatilla National Forest, the Mid-Columbia River Steelhead ESU consists of the upper reaches of the main stem of the John Day River, the lower reaches of Middle Fork John Day River, the upper reaches of the Umatilla River, and the Walla Walla River. The Grande Rhonde, Asotin, and Tucannon River drainages are part of the Snake River Basin Steelhead ESU. Of all these drainages, only the uppermost reaches of the Touchet River (Snake River Basin ESU) contain steelhead showing "strong" trends; the rest have declining populations. On the Wallowa-Whitman, the upper reaches of the Umatilla and North Fork John Day River drainages are part of the Mid-Columbia ESU. The upper reaches of the Grande Rhonde and Imnaha drainages are part of the Snake River Basin ESU. Both ESUs on the Wallowa-Whitman National Forest consist mostly of "depressed" populations of steelhead. There are no known areas showing "strong" trends for steelhead. All steelhead on both Forests are Federally Threatened. The Snake River Basin Steelhead ESU is not presently in danger of extinction, but it is likely to become endangered in the near future. While total (hatchery + natural) run size has increased since the mid-1970s, there has been a recent, severe decline in the natural run. Most natural stocks in these ESUs, for which data is available, have been declining (Busby, et. al., 1996).

Figure III-2: Landscape Defoliation

The Umatilla National Forest has no known populations of ocean-type fall chinook, although individuals may be present within National Forest boundaries. Stream-type chinook salmon occur in two ESUs. The Mid-Columbia River Spring Run ESU includes the Klickitat, Deschutes, John Day, and Yakima Rivers. Several tributaries in the southern part of the Forest that originate in the North Fork John Day River contain "depressed" populations. The Snake River Spring/Summer-Run ESU includes populations of spring- and summer-run chinook salmon from the Snake River Basin. On the Umatilla, there are several sites where stream-type chinook salmon populations are depressed: Grande Rhonde River (including the Wenaha River drainage), Tucannon River, and Asotin River. The Wallowa-Whitman Forest has widely scattered, depressed populations of stream-type chinook salmon on part of both ESUs. The Mid-Columbia ESU includes the upper reaches of the North Fork John Day and some tributaries. This is the only area on the Wallowa-Whitman with a declining population of spring-run chinook. The Snake River Spring/Summer ESU includes the upper reaches of the Grande Rhonde River and some tributaries, the upper reaches of the Wallowa River, and the Imnaha River. These areas all contain depressed populations of chinook. The Mid-Columbia River Spring Chinook ESU is not presently in danger of extinction nor likely to become extinct in the near future (Myers, et al. 1998). Two major river basins (John Day and Yakima River) are mostly comprised of naturally produced fish and both exhibit long-term increasing trends in abundance (Myers, et. al., 1998). The Snake River Spring/Summer ESU is listed as Federally Threatened.

In addition, the Wallowa-Whitman National Forest borders migratory habitat for Snake River sockeye salmon. This species is listed as federally endangered. There also appears to be a small population of landlocked sockeye salmon on the Wallowa-Whitman National Forest in the upper reaches of the Wallowa River drainage, particularly in the Wallowa River and/or Wallowa Lake.

A portion of the CHU for the Snake River chinook salmon occurs within the Umatilla National Forest. The designated habitat occurs within a 300 feet buffer of the following streams: main stem Tucannon and all tributaries except for Pataha; main stem Asotin and all tributaries except George Creek; main stem Wenaha and all tributaries; main stem Grande Rhonde only; Lookingglass Creek and all tributaries. A portion of the CHUs for the Snake River Chinook Salmon and Snake River Sockeye Salmon occur within the Wallowa-Whitman National Forest. This designated habitat occurs within a 300 feet buffer of all the streams within the Forest.

There are more than 280 linear miles of occupied anadromous fish habitat in host type on the Umatilla and 710 miles on the Wallowa-Whitman.

MALHEUR AND OCHOCO NATIONAL FORESTS

The Mid-Columbia River Inland Steelhead ESU includes portions of the Ochoco and Malheur National Forests. Steelhead trout are found only in the northern portion of each Forest, in varying population strength. On the Ochoco Forest, steelhead live in the upper reaches of the Bridge and Rock Creek drainages (John Day River system) and in the upper reaches of the Trout Creek drainage that feeds into the Deschutes River. All the Ochoco steelhead populations are declining. Steelhead also occupy the upper reaches of the main stem of the John Day River, just outside the Malheur Forest boundary. Population in this area has decreased, although the headwaters, which are on

the Forest, show improvement. Canyon and Murderers Creeks, on-Forest tributaries of the John Day, also have strong populations of steelhead. Steelhead in the upper reaches of the Middle Fork of John Day River (on the Malheur Forest) have "depressed" populations; a tributary, Camp Creek, has a steelhead population that is exhibiting strong trends.

Each of these steelhead populations is federally threatened. While the Mid-Columbia steelhead ESU is not presently in danger of extinction, its likelihood of becoming endangered in the near future is unknown. Total steelhead abundance in the ESU appears to have recently increased, but most of the natural stocks for which data is available have declined. This includes those in the John Day River, the largest producer of wild, natural steelhead (Busby et al. 1996).

On the Malheur Forest, there are 200 linear miles of occupied anadromous fish habitat in host type; there are 120 miles on the Ochoco.

Bull Trout (Salvelinus confluentus)

Bull trout are native to western North America. They are non-anadromous and live in a variety of cold-water habitats, including small streams, large rivers, and lakes or reservoirs (cited in Meehan, 1991). Temperature appears to be a limiting factor to many Oregon bull trout populations. Since these populations are in at the southern end of their natural range, they could be threatened by land or water activities that increase temperature (Buchanan, et. al., 1997). Removal of riparian vegetation can cause a local increase in temperature. Bull trout occur on all 9 Forests in the project area and include two distinct population segments ("DPS"): the Columbia River Basin DPS and the Klamath River DPS. Both populations were listed as federally threatened by the U.S Fish and Wildlife Service in 1998. *Occupied bull trout habitat* is defined in this analysis as occupied by bull trout for spawning and rearing, year-round resident use, holding, migrating, or seasonal use. On many Forests, this information is not definitively known; some areas "suspected" to provide the habitat were also included. Only host type within 300' of occupied bull trout streams was evaluated. Emphasis was placed on stream segments that are *303d*-listed for elevated stream temperature. The following describes the current condition of bull trout within the project area as it relates to the potential for a Douglas-fir tussock moth outbreak.

Columbia River Basin Distinct Population Segment: The Columbia DPS includes bull trout in portions of Oregon, Washington, Idaho, and Montana. Six of the nine project Forests contain subpopulations of this bull trout population: the Colville, Okanogan, Wenatchee, Umatilla, Wallowa-Whitman, and Malheur. Bull trout are thought to have once occupied 60% of the Columbia River Basin; they now occupy just 4% of that original range (USDI, 1998).

COLVILLE NATIONAL FOREST

Three subpopulations of Columbia River bull trout are estimated to occur on the Colville in Slate Creek, Sullivan Creek, Le Clerc Creek, Mill Creek, and Cedar Creek (Pend Oreille County). None are *303d* listed. There is only one known population on the Forest and no verified reds. Only individual sightings of bull trout have been documented. An occasional juvenile has been observed on Le Clerc Creek, a tributary of the Pend Oreille River, since 1993, although the location of their spawning and rearing sites(s) have yet to be found (T. Shuhda, pers. comm., 1999). There are approximately 65 linear miles of bull trout habitat in DFTM host type.

OKANOGAN NATIONAL FOREST

Four subpopulations are known to occur on the Methow Valley Ranger District (USDI, 1998), found in the Beaver Creek, and Chewuch, Lost, and Twisp Rivers, and their tributaries. The Chewuch and Twisp subpopulations are relatively low in abundance. The Lost River subpopulation appears to be healthy and stable. Bull trout in Beaver Creek are the only known subpopulation isolated from the others (B. Baer, pers. comm., 1999). The main limiting factors for Columbia River bull trout within the Methow River watershed are unsuitable habitat caused by water diversions and population isolation. The Twisp and Methow Rivers are the only known bull trout occupied streams that have segments that exceed state requirements for stream temperatures. These stream segments are located off the Forest on private lands. One hundred linear miles of occupied bull trout habitat are in host type.

WENATCHEE NATIONAL FOREST

The Wenatchee National Forest provides habitat for bull trout in three major tributaries of the Columbia River: the Wenatchee, Entiat, and Yakima Rivers (USDI, 1998). Significant spawning activity has been recently observed in White River, a tributary of Lake Wenatchee. Populations are also showing improvement in the Chiwawa Watershed and Rimrock Lake (Tieton River), including both Indian Creek and South Fork Tieton Creek. Monitoring in these systems indicates "healthy" populations that appear to be either increasing or stable. The population status in the rest of the Wenatchee River drainage, including Nason Creek, Little Wenatchee River, Chiwaukum River, and Icicle Creek, appears to be depressed. The status of the Deep and Ingalls Creek populations are unknown. Mad River (Entiat River tributary) bull trout appear stable.

There is some spawning in the Entiat River downstream of Entiat Falls, but numbers are very low; this subpopulation appears to be depressed (USDI, 1998; K. Macdonald, pers. comm., 2000). Within the Naches sub-basin, bull trout are found in the American River, Crow Creek, Rattlesnake Creek, and Bumping River. The bull trout population within Rattlesnake Creek, a tributary of the Naches River, appears to be stable with spawning occurring at relatively low numbers. Juveniles have been observed in the lower portion of several other tributaries of Little Naches River (K. Macdonald, pers. comm., 2000).

Within the Yakima sub-basin, bull trout are found in the North Fork Teanaway, Lake Kachess, Lake Cle Elum and Cle Elum River, and Lake Keechelus, including Gold Creek and Waptus River. Populations appear to be either stable or depressed (K. Macdonald, pers. comm., 2000).

The primary limiting factors to bull trout on the Wenatchee National Forest has been extensive fish harvest, habitat modification, and off-Forest development. Elevated stream temperatures may be a problem in some streams. Habitat alteration may have raised temperatures in some tributaries, but other stream temperatures are close to historic levels. This includes stream segments on the *303d* list (K. Macdonald, pers. comm., 1999). Host type stands include 45 linear miles of occupied bull trout habitat.

UMATILLA NATIONAL FOREST

Six watersheds provide habitat for Columbia River bull trout: Asotin, Grande Ronde, John Day, Tucannon, Umatilla, and Walla Walla Rivers (USDI, 1998). Bull trout in the headwaters of Asotin Creek are considered a depressed population (J. Sanchez, pers. comm., 1999 and Quigley et. al. 1997).

The Grande Ronde Watershed has bull trout in the main stem of the Grande Ronde River, Lookingglass Creek, and the Wenaha River. The Lookingglass population has declined; the *303d*-listed stream segment does not meet State water temperature standards. The Wenaha River and its associated tributaries have subpopulations of bull trout that are considered "strong". Part of this river is also listed on the *303d* list as not meeting State standards for water temperature (Quigley et. al. 1997; J. Sanchez, pers. comm., 1999).

Desolation Creek (John Day River watershed) has a "depressed" population. Like most John Day River tributaries, a segment Desolation Creek is listed on the *303d* state list for exceeding State water temperature standards (J. Sanchez, pers. comm., 1999).

The Tucannon River Watershed contains bull trout in Cummings Creek and the headwaters of Tucannon Creek. Both are considered "depressed" populations. (Quigley, et. al., 1997; J. Sanchez, pers. comm., 1999). Some Tucannon Creek headwaters are listed for stream temperature.

The Umatilla River Watershed contains Columbia River bull trout in the North Fork of Umatilla Creek and in Meacham Creek, with the North Fork providing most of the spawning and rearing habitat. Stream segments of both are listed on the *303d* list as being above State requirements for stream temperature.

The Walla Walla River Watershed contains bull trout in headwaters of two stems of the Walla Walla River and in Mill Creek. Although the Mill Creek subpopulation is showing improvement, the Walla Walla River headwater populations have declined (J. Sanchez, pers. comm., 1999). One segment of the Walla Walla River is *303d* listed for water temperature.

Limiting factors for Umatilla bull trout include small populations of mostly resident fish that are isolated by impassably warm water. Bull trout in the John Day Watershed also suffer from competition with brook trout. Stream temperature is more of a limiting factor in the southern part of the Forest where weather conditions are hotter and drier and where cattle grazing is common (J. Sanchez, pers. comm., 1999). There are approximately 180 linear miles of bull trout habitat in DFTM host type.

WALLOWA-WHITMAN NATIONAL FOREST

The Grande Ronde River, John Day River, and Salmon River watersheds provide habitat for Columbia River bull trout on the Wallowa-Whitman National Forest. In the Grande Ronde watershed, bull trout are found in the main stem of the Grande Ronde, lower reaches of the Wallowa River, Minam River, and Little Minam River. Of these, the Wallowa River population is classified as "depressed". Minam populations appear to be improving (Quigley, et. al., 1997).

In the John Day River watershed, only the North Fork John Day River and its tributaries provide bull trout habitat; the population is declining (Quigley, et. al., 1997).

Bull trout in the Salmon Watershed have been increasing in number, particularly in Big Sheep Creek and Rapid River and their tributaries. Other locations providing habitat for bull trout are the main stem of the Snake and Imnaha Rivers (plus tributaries). Their population status is unknown (Quigley, et. al., 1997).

Overall, many stream segments are *303d* listed for elevated stream temperature. There are approximately 180 linear miles of bull trout habitat in DFTM host type.

MALHEUR NATIONAL FOREST

The John Day Watershed provides habitat for bull trout in the following areas, the populations of which are all considered to be "depressed": Big Creek, Clear Creek (John Day River tributary), Indian Creek, upper reaches of John Day River, and Reynolds Creek (Quigley, et. al., 1997). The Malheur River watershed also contains "depressed" populations of bull trout: Little Crane Creek and some tributaries, upper reaches of the Malheur River, and Summit Creek and its tributaries (Quigley, et. al., 1997).

About half have segments on the *303d* state list for exceeding state stream temperature requirements. There are nearly 130 linear miles of bull trout habitat in DFTM host type.

OCHOCO NATIONAL FOREST

Although bull trout are believed to exist on the Ochoco Forest, no reaches have been verified as containing a subpopulation. The only documented reach (9 miles) with a known population of bull trout is west of the Forest, on the Crooked River National Grasslands, and outside the analysis area

Klamath River Distinct Population Segment: Historical records suggest that bull trout were once widely distributed and exhibited diverse life-history traits in the Klamath River Basin (USDI, 1998). Today, bull trout occur only as resident forms in isolated, high elevation headwater streams. They are found in only three watersheds: Upper Klamath Lake, Sprague River, and Sycan River (USDI, 1998). Contributing factors include habitat degradation, water diversion, and habitat fragmentation. In addition, long distances now separate each of the 7 subpopulations (C. Speas, pers. com., 1999).

WINEMA NATIONAL FOREST

One of the seven subpopulations of Klamath River bull trout occurs entirely on the Winema National Forest, in four miles of Threemile Creek. The population is considered to be at risk of extirpation, with less than 100 known individuals (D. Forbes, pers. comm., 1999). The main limiting factors to this subpopulation are its isolation and competition from brook trout (D. Forbes, pers. comm., 1999). Most of Threemile Creek is *303d* listed for exceeding maximum stream temperature. However, previous temperature data might not be an accurate representation of the current situation. Recent temperature surveys show the upper section, which contains bull trout, is within acceptable levels (D. Forbes, pers. comm., 1999). DFTM host type borders only 2 linear miles of occupied bull trout habitat.

FREMONT NATIONAL FOREST

Five subpopulations of the Klamath River bull trout occur on the Forest and on surrounding private lands: Long Creek, Coyote Creek, North Fork Sprague River and its tributaries, Demming Creek, Brownsworth Creek, and Leonard Creek. All, except the Demming Creek population, are considered to be at risk from extirpation (USFS, 1998). The Demming Creek population is the strongest bull trout subpopulation in the Klamath Basin (C. Spears, pers. comm., 1999). Some portions of each of the bull trout occupied streams are *303d* listed for stream temperature. Unfortunately, the data to determine *303d* status was taken during a drought and may not be an accurate representation of current temperatures (C. Speas, pers. comm., 1999). Approximately 5 linear miles of occupied bull trout habitat is in DFTM host type.

Gray Wolf (Canis lupus)

Wolves are highly social animals, occurring in packs that establish and defend territories ranging from 48 square miles to over 981 square miles depending on pack size and prey density (Ballard, et al., 1997; Mech, 1987; Wise, et. al., 1991). This species inhabits a wide variety of habitats in which it requires an adequate food supply, suitable denning and rendezvous sites, travel corridors, and regulation of human caused mortality (USFWS 1987).

Two primary habitat components have been identified as important to wolf conservation: availability of prey and freedom from direct mortality (Fritts, 1994). Wolves prey primarily on ungulates, although birds and smaller mammals are taken when available (Mech, 1970). Freedom from direct mortality is measured by changes in road densities. Wolves do not appear to avoid habitat associated with roads, but rather increases in road densities heightens the chances for direct mortality to wolves from poaching.

The Colville, Okanogan, and Wenatchee have had documented occurrences of the gray wolf. There have also been recent confirmed sightings of the gray wolf on all three Forests. The most likely habitat for this species is in areas of low road densities. This species has not been documented to occur on any of the other National Forests in the analysis area.

These three Forests, located in eastern and central Washington, contain habitat to support the entire home range necessary for the wolf. This includes den and rendezvous sites, abundant ungulate food base, as well as large tracts of land with low road densities.

There are no known rendezvous or den sites on the Colville National Forest. There are no known den sites or confirmed rendezvous sites on the Okanogan National Forest. There are no known den sites on the Wenatchee National Forest, although there are two known rendezvous sites. Ungulates are considered the main source of prey for wolves on the Colville National Forest. Deer and elk are common throughout the Forest, while caribou are present in small numbers within its northeast corner. Deer and occasionally small mammals and birds are suspected to be the main prey base for wolves on the Okanogan National Forest. Deer and elk are most likely the main prey base for wolves on the Wenatchee National Forest. Snow-intercept thermal and thermal cover are important habitat components for ungulates throughout the three Forests.

Calving and fawning areas for ungulates are mostly concentrated in the wide river bottoms and riparian areas where water, food, and shelter are in close proximity (cited in USDA 1991).

Woodland Caribou (Rangifer tarandus caribou)

Winter foraging is limited almost exclusively to lichens hanging from subalpine fir and Engelmann spruce trees. Throughout the rest of the year, caribou eat herbaceous vegetation, mushrooms, shrub leaves, grasses, sedges, and soft shrubs. In central British Columbia, caribou are known to forage in early winter at lower elevations under the tree canopy. The canopy cover intercepts snow and makes ground foraging easier. In summer, canopy cover offers protection from the heat and possibly insects (cited in USFWS, 1985).

Woodland caribou are known to commonly have large home ranges and low population densities (cited in USFWS, 1985). Although the Selkirk Mountain herd is thought to move freely between the United States and British Columbia, it is likely that the caribou use the United States habitats throughout the year. Observations of the species have been made in the U.S in every month of the year (cited in USFWS, 1985).

The Selkirk Mountain caribou are an ecotype of woodland caribou occupying the international border areas of northern Idaho, Washington, and southern British Columbia. The Selkirk population is the only woodland caribou herd frequenting the contiguous United States. They are also the only population listed as endangered. The Selkirk Mountain caribou inhabit the northeastern corner of the Colville National Forest, on the Sullivan Lake Ranger District. On the Colville National Forest, about 36,000 acres were delineated as caribou habitat. This area consists of the Salmo-Priest Wilderness, research natural areas, and lands available for timber harvest.

Grizzly Bear (Ursus arctos horribilis)

The grizzly bear is an omnivorous and secretive animal with movement patterns and variable habitat preferences highly influenced by their search for available seasonal foods. Seasonal foods include carrion, preying on ungulates, small mammals, fish, insects, herbaceous plants, roots, bulbs, tubers, fungi, tree cambium, berries, and nuts (Martinka, 1972; Pearson, 1975; Hamer, et. al., 1977; Singer, 1978). The pattern of grizzly bear movements in the Northern Rockies is to emerge from high elevation snow covered den sites in April, descend to lower elevations to reach palatable emerging vegetation and feed on carrion or weakened ungulates. From late spring through early summer grizzly bear follow the "greening up" of vegetation, seeking similar forage components as early spring. During late summer and fall grizzly bear feed on ripening berries to build up critical carbohydrate reserves needed to maintain body weight during winter denning (Sevheen and Lee, 1979).

Craighead, et al. (1982) described seven characteristics essential to grizzly bear habitat: space, isolation, sanitation, denning, safety, vegetation types, and food. When any one of these components is missing, the viability of grizzly habitat rapidly diminishes (Almack, 1986).

Almack, et. al., (1993) identified 22 Class I (confirmed) and 82 Class II (high reliability) observations in the North Cascades of Washington and the Southern Cascades of British Columbia, Canada. The Wenatchee, Okanogan, and Colville National Forests have documented occurrences of grizzly bears within their boundaries. The northern and central portions of the Wenatchee National Forest occur within the North Cascades Grizzly Bear Recovery Zone and include the Chelan, Cle Elum, Entiat, Lake Wenatchee, and Leavenworth Ranger Districts. The portion of the Okanogan National Forest, specifically the Methow Valley Ranger District and the far western portion of the Tonasket Ranger District, occurring west of the Okanogan River is also located within the Recovery Zone. The grizzly bear recovery zone within the Colville National Forest occurs within and east of the Pend Oreille Valley, within the Sullivan Lake Ranger Districts.

Canada Lynx (Lynx canadensis)

Lynx occur primarily in the boreal, sub-boreal, and western montane forests of North America (Koehler and Aubry, 1994). Primary lynx habitats in Washington and Oregon are dominated by Engelmann spruce, subalpine fir, and lodgepole pine (Koehler 1990).

Snowshoe hares are the primary prey of lynx, comprising 35-97% of the diet throughout the range of the lynx (Koehler and Aubry, 1994). There is little research on lynx diet specific to the southern portion of its range except in Washington (Koehler, et. al. 1979, Koehler, 1990). In areas characterized by patchy distribution of habitat, alternate prey could include white-tailed jackrabbit, black-tailed jackrabbit, ground squirrels, sage grouse, and Columbian sharp-tailed grouse (cited in USDI 1999). Early successional forests and structurally diverse older stands supporting forage for snowshoe hares provide foraging habitat for lynx. In Washington, hares were more abundant in younger aged stands of lodgepole pine than in any other forest type (USDA 1994b).

The common component of lynx denning habitat is large woody debris, either downed logs or root wads (cited in USDI 1999). Stand structure appears to be of more importance than forest cover type. Large amounts of large coarse woody debris provide escape and thermal cover for kittens (cited in USDI 1999).

The following Forests within the project area have documented occurrences of lynx: Colville, Okanogan, Wenatchee, Wallowa-Whitman, Umatilla, and Fremont. The Winema and Ochoco Forests have suspected occurrences of lynx.

Historical and current lynx distribution is primarily east of the Cascade Mountains in Washington, mainly on the Okanogan National Forest (Washington Department of Fish and Wildlife 1993). Lynx distribution on the east side of the Washington Cascades appears to be closely related to the distribution of the subalpine fir/Engelmann spruce plant associations which have lodgepole pine as a seral species (Koehler and Brittel, 1990).

Current records indicate a similar distribution, but with fewer reports from some areas, such as the Colville National Forest, located in northeastern Washington. Lynx have been documented at elevations ranging from 3,000 feet to near the upper tree line. The lower limit, near 3,000 feet, is closely correlated with cool/moist habitat types. Lynx appear to make use of the lower elevation western redcedar and hemlock forest within the landscape, a trait perhaps unique to this region (cited in USDI 1999). Portions of the Wallowa-Whitman, Umatilla, Ochoco, and Malheur National Forests may provide connective / dispersal habitat to support movement between the northern Rocky Mountains and the Oregon Cascades. Information of lynx occurrence in central Oregon is limited (cited in USDI 1999).

Northern Bald Eagle (Haliaeetus leucocephalus)

The entire project area is incorporated within the Pacific Bald Eagle Recovery Plan (USFWS, 1986). Bald eagle nests within this Recovery Plan area are usually located in multi-storied stands with old-growth components, and are near water bodies that support an adequate food supply

(USFWS 1986). Adequate forage sources are possibly the most critical component of bald eagle breeding and wintering habitat. Fish, waterfowl, rabbits, and various types of carrion comprise the most common food sources for eagles in the Pacific Recovery Plan area. Wintering bald eagles perch on a variety of substrates, proximity to a food source being the most important factor influencing perch selection. Eagles tend to use the highest perch sites available that provides a good view of the surrounding area (USFWS 1986). Communal roost areas are invariably near a rich food source and in forest stands that are multi-storied and have at least a remnant old growth component (USFWS, 1986).

Habitat loss is the most significant threat to bald eagle populations in the 7-state recovery area. It is recommended in the Pacific Bald Eagle Recovery Plan that forested habitat being presently used by eagles be maintained (USFWS, 1986). The increasing disappearance of old growth and late/old structure stands makes it imperative that existing habitat be protected where appropriate. The Recovery Plan also states that in some cases special actions should be taken to maintain existing habitat for the bald eagle (USFWS, 1986).

The bald eagle is listed by the U.S. Department of Interior as a threatened species in Washington and Oregon. The primary threat to bald eagles in Washington and Oregon has been habitat degradation (WDW 1989). The entire analysis area falls within the 7-state Pacific Recovery Area for the bald eagle. Seven of the nine National Forests within the analysis area have recently had active bald eagle nests occur on NFS lands and are as follows: Colville, Wenatchee, Umatilla, Wallowa-Whitman, Ochoco, Winema, and Fremont. There are no recent, active bald eagle nests on the Malheur and Okanogan. There is potential habitat and known bald eagle nest sites nearby. Typically, 0.25 miles (125 acres) surrounding bald eagle nests is considered core habitat for the species in the Pacific Northwest (G. Gunderson, per. com. 1999).

Northern Spotted Owl (Strix occidentalis caurina)
Studies of habitat use suggest, with few exceptions, that stands with old-growth forest structural components are superior habitat for the northern spotted owl (USDA 1992). Spotted owls consistently concentrate their foraging and roosting in old-growth or mixed-age stands of mature and old-growth trees (USDA 1992). For nest sites, spotted owls primarily use old-growth trees, whether in old-growth stands or in remnant old-growth patches (USDA, 1992). The diet of spotted owls consists primarily of small mammals. Wood rats and flying squirrels compose the majority of the prey biomass eaten by these owls (USDI, 1992).

The northern spotted owl is a medium-sized owl found primarily in western Washington and Oregon of the Pacific Northwest, and is listed as a threatened species under the Endangered Species Act. The analysis area includes the eastern most edge of the range of the spotted owl and includes the Wenatchee National Forest, and the western parts of the Okanogan and Winema National Forests. The eastern portion of the Okanogan and Winema National Forests are considered to be outside the range of the species.

Spotted owl populations on the Okanogan and Wenatchee National Forests occur in the **Eastern Washington Cascades province**, located east of the Cascade Crest from the Columbia River north to the Canadian Boarder. Most spotted owl habitat in this area is found in the Yakima Indian Reservation and four Ranger Districts on the Wenatchee National Forest: Naches, Cle Elum, Leavenworth, and Lake Wenatchee. Much of the region is dominated by high-elevation mountains and ridge-tops that are not suitable spotted owl habitat. These topographic features restrict the suitable spotted owl habitat to low-elevation, mixed conifer forests. Much of these lower elevation habitats have been logged extensively, but primarily with partial-harvest techniques. Spotted owls and their habitat are poorly distributed in the portion of the Okanogan National Forest within the range of the species, and the Chelan and Entiat Ranger Districts of the Wenatchee National Forest (USDI, 1992).

The eastern Washington Cascades province is isolated somewhat from other spotted owl subpopulations on its northern, southern, and western boundaries. The two spotted owl provinces that comprise the Washington Cascades are connected by contiguous habitat and owls in only a few areas. The northern portion of the province is virtually at the edge of the species' current range, and the few spotted owls within this region are isolated from the larger groups of owls south of Lake Chelan. The degree of province isolation in the Columbia River area is unknown (USDI, 1992).

Spotted owl nest stands within the Okanogan and Wenatchee National Forests are dominated by Douglas-fir and grand fir, with some ponderosa pine, western larch, western red cedar, and western hemlock. The nest stands are found either in old growth habitat, or young/mature stands containing remnant old-growth trees (USDI, 1992). In one study in the eastern Washington Cascades, total canopy cover averaged 75 percent in 62 nest sites and 72 percent in the stands within which the nests were found (USDI, 1992). In the same province, total canopy cover in roosting and foraging sites averaged 47 percent in six home ranges (USDI, 1992).

The spotted owl population on the Winema National Forest occurs within the **Eastern Oregon Cascades province**. This province consists of a narrow band of habitat extending north-to-south along the east side of the Cascade crest from the Columbia River to the California border. Habitat suitability for the owls within the Winema National Forest is found in the mixed conifer zone existing between the high-elevation subalpine and mountain hemlock forests and the lower elevation lodgepole / ponderosa pine areas. Habitat and owls are poorly distributed through many areas of the province, including the Winema National Forest. Natural conditions (e.g. soils and moisture conditions), past fire history, and timber harvest have contributed to the isolated nature of the

habitat. In addition, the high-elevation subalpine and non-forested conditions along 40 percent of the Cascade crest makes the eastern Oregon Cascades province relatively isolated from the western Cascade province (USDI 1992).

There is a significant potential for large-scale fire in the eastern Washington (Okanogan and Wenatchee National Forests) and Oregon (Winema National Forests) Cascade province. A total fire suppression strategy has created the multi-layered yet unstable forest structure present on this landscape today. There is a very low probability that any conservation area in the East Cascades subregion will avoid catastrophic wildfire over a significant portion of the landscape over the next century. As spotted owls in the province currently are clustered in a few key areas, fire poses a severe natural threat to population recovery (USDI 1992).

Fire exclusion, coupled with natural mortality factors, gradually reduces the pine and larch components of mixed conifer stands. Thus, the resulting multistoried stands of Douglas-fir and true fir create conditions for the buildup of defoliators, such as the western spruce budworm and Douglas-fir tussock moth. Populations are predicted to increase, with more frequent outbreaks (USDI 1992).

SENSITIVE SPECIES

Forest Service Manual 2670.5 directs the Regional Forester to identify species for which there is a viability concern as evidenced by a) significant current or predicted downward trends in population numbers or density or b) significant current or predicted downward trends in habitat capability that would reduce a species' existing distribution. Once "sensitive species" have been identified, the Forest Service must assess the effects of actions or projects on such species and ensure that those actions or projects do not cause a loss of species viability or create significant trends toward Federal listing (*FSM 2670.32*). Habitat for these species is widely varied, ranging from aquatic environments to upland forests, shrub lands, and grasslands. Table III-10, below, displays the 35 documented (D) or suspected (S) occurrence of sensitive species on National Forests within the analysis area.

Table III-10: Regional Forester's List of Sensitive Animal Species in the Project Area

	COL	OKA	WEN	UMA	W-W	MAL	OCH	WIN	FRE
AMPHIBIANS									
Larch Mountain Salamander			D						
Oregon Spotted Frog								S	S
Columbia Spotted Frog		D		D	D	D	D		
Northern red-legged frog			D						
BIRDS									
Common loon	S	D	D			D	D	D	
American white pelican		D	D					D	D
Ferruginous hawk			D						
American Peregrine Falcon	S	S	D	S	S	S	S		D
Western sage grouse						D	D		D
Greater sandhill crane		S	D		D	D	D	D	D
Long-billed curlew		D	S		D	D	D	D	D
Upland sandpiper			S		D	D	S		
Tricolored blackbird					D	S	S	S	S
Harlequin duck	D	D	D		D				
Yellow rail								D	S
Black rosy finch				S	D				
FISH									
Interior redband trout	D	D	D	D	D	D	D	D	D
Oregon Lakes tui chub									S
Goose Lake Sucker									D
Klamath largescale sucker								D	D
Malheur mottled sculpin						D	D		
Pit sculpin									D
Slender sculpin								D	S
Mid Columbia fall chinook salmon							I		
Mid Columbia spring chinook salmon			D	D		D	I		
INVERTEBRATES									
Schuh's homoplectran caddisfly								S	
Cascades apatanian caddisfly								S	
Blue Mountain cryptochian caddisfly				S	D	D	D		
Ft. Dick limnephilus caddisfly								S	
MAMMALS									
Preble's shrew					D	D	D		
Pacific western big-eared bat		D	D					S	
Pygmy rabbit						S	S		D
California wolverine	D	D	D	S	D	D	D	D	S
California bighorn sheep	D	D	D	D	D	D	D		D
REPTILES									
Northwestern pond turtle			S					D	D

MANAGEMENT INDICATOR SPECIES & OTHER WILDLIFE

Management Indicator Species (MIS) are a group of wildlife species that represent other wildlife species with similar habitat requirements, and which are the focus of management and monitoring on the National Forests. Forest management is prescribed to ensure viability of these selected species as well as other species that they represent. Protection of these species is based upon the habitat requirements of the MIS.

Table III-11, below, is a list of the Management Indicator Species considered in this analysis

Table III-11: Management Indicator Species

	COL	OKA	WEN	W-W	UMA	MAL	OCH	WIN	FRE
BIRDS									
Bald Eagle			X	X		X	X	X	X
Golden Eagle							X		
Peregrine Falcon			X	X		X			X
Prairie Falcon							X		
Goshawk				X				X	X
Spotted Owl		X	X					X	
Barred Owl	X	X							
All Primary Cavity Excavators	X	X	X	X	X	X	X	X	X
Pileated Woodpecker	X	X	X	X	X	X	X	X	X
Three-toed Woodpecker	X	X	X	X	X	X		X	X
Red-Naped Sapsucker									X
White- headed Woodpecker				X		X			
Northern Flicker							X		
Great Blue Heron	X								
Blue Grouse	X								
Ruffed Grouse		X	X						
Franklin's Grouse	X								
FISH									
Steelhead		X			X	X	X		
Chinook salmon		X	X			X			
Westslope Cutthroat trout			X						
Resident trout	X	X			X		X	X	X
Anadromous fish				X					
MAMMALS									
Elk			X	X	X	X	X		
Deer	X	X	X			X	X	X	X
Mountain Goat			X						
Mountain Caribou	X								
Grizzly Bear	X								
Lynx		X							
Pine Marten	X	X	X	X	X	X		X	X
Beaver	X		X						
Northern Bog Lemming	X								

LEPIDOPTERA

Studies have identified from 458 to 498 species of moths and butterflies in a typical coniferous forest (Grimble, 1995; Miller, 1995). Most of these species (approximately 80%) are adapted for growth in early spring to coincide with new foliage for feeding. Different geographic areas throughout the Forest of eastern Washington and Oregon have roughly the same number of species; of those species, perhaps 20% may differ between geographical regions (Hammond, pers. comm.). Most species belong to the Noctuidae and Geometridae families (Grimble, 1995; Miller, 1995). In eastside western coniferous forests, approximately 12% of the moth species, and 5% of the moth abundance are found in the conifer habitat. Most of the species occur in hardwood habitat (52%) and herb/grass habitat (33%) (Hammond and Miller, 1998). There are no federally threatened or endangered Lepidoptera within the project area. There are no Lepidoptera on the Regional Forester's Sensitive species list. The Mardon skipper (*Polites mardon*) is a candidate for Federal listing. This insect is also a Washington Department of Fish and Wildlife State listed species. It does not occur within the analysis areas of this EIS in Washington. There are also 11 species of butterflies on the Washington State candidate list. Four are known to occur within the analysis area: Juniper Hairstreak (*Callophrys [Mitoura] gryneus*), Silver-bordered Fritillary (*Boloria selene*), Great Arctic (*Oeneis nevadensis*), and Shepard's Parnassian (*Parnassius clodius shepardi*). Two other species, the Johnson's Hairstreak (*Callophrys johnsoni*) and the Yuma skipper (*Ochlodes yuma*) have not been found in the project area (information based on *Butterflies of North America; Butterflies of Washington*).

Oregon does not have any State listed Lepidoptera. There have been confirmed sightings of the Mardon skipper in Klamath County. There are some analysis areas on the Winema NF that occur within this County, however, it is not known whether Mardon skipper colonies occur in the vicinity of these areas. Two species listed as rare or local throughout its range by the Nature Conservancy are the Sierra Nevada Blue (*Agriades podarce*) and the Johnson's Hairstreak. The Sierra Nevada Blue has been recorded in Klamath County, which contains analysis areas on the Winema NF. The Johnson's Hairstreak has not been recorded in any counties containing analysis areas. Eleven other species that may be considered rare in parts of their range or because they occur on the periphery of their range, or as a subspecies, include Rural Skipper (*Ochlodes agricola*), Gold-hunter's Hairstreak (*Satyrium auretorum*), Long Dash (*Polites mystic*), Eastern Meadow Fritillary (*Boloria bellona toddi*), Barnes' Crescent (*Phyciodes pallidus barnesi*), Peck's Skipper (*Polites peckius* (=*coras*)), Beartooth Copper, (*Lycaena phalaeas arctodon*), Hoary Elfin (*Incisalia polia obscura*), Garita Skipperling (*Oarisma garita*), Yuma Skipper (*Ochlodes yuma*), and Silver-bordered Frillary (*Boloria selene tollandensis*). This information is based on *Butterflies of North America; Butterflies of Oregon*, and Scott, 1999.

DOUGLAS-FIR TUSSOCK MOTH

BACKGROUND AND LIFE CYCLE

The Douglas-fir tussock moth is a native defoliator that occurs throughout the west from southern British Columbia to Arizona and New Mexico, and east to Colorado. It was first recorded in 1900, and the first outbreak was recorded in British Columbia in 1916. Although the insect occurs throughout the west, outbreaks most frequently occur east of the Cascades and west of the Rockies. It can be found west of the Cascades, but never reaches outbreak proportions. The first details of a large infestation in the U.S. are from an extensive outbreak that occurred in the Northwest in 1927-1930. Since then, a variety of major and minor outbreaks continued to be recorded throughout the interior forests of the western U.S. (Mason and Wickman, 1988). The most recent widespread outbreak in the Pacific Northwest (Oregon, Washington, and Idaho) occurred in 1972-1974 when almost 700,000 acres were defoliated. A more recent smaller outbreak occurred in northeastern Oregon on the Pine Ranger District; 116,000 acres were treated in 1991. At that time, a large outbreak covering 418,000 acres occurred in southern Idaho (Weatherby, et. al., 1997). The most recent outbreak occurred in California, 1996-1999.

Douglas-fir tussock moths reproduce one time per year. The eggs are laid in the fall on the underside of branches with usually 150-250 eggs per mass. The insect over-winters in the egg stage. Eggs hatch in the early spring at the same time that buds break and new shoots begin to expand. These events are closely synchronized. The young larvae feed on the new shoots, and then switch to older needles as they mature. Trees that are being defoliated have a red appearance. The larvae feed for about 60 days, spin cocoons, pupate for about 2 weeks, and emerge as adults. The females are wingless and remain on the cocoon. The male finds the female by a sex attractant or pheromone. After she mates, the female deposits her eggs on the cocoon.

The cyclic nature of Douglas-fir tussock moth populations is well documented (occurring every 7 –10 years), although these cyclic peaks do not always reach outbreak levels (Mason, 1996). A number of theories have been proposed to explain this cyclic nature, but the actual reasons are not known. Population peaks do not always go to outbreak. What happens to the larval generations in the early phase of the population cycle will determine whether the populations will cross to outbreak levels or return to low levels. Once a population reaches outbreak levels, the outbreak rarely persists in the same stand for more than 2-3 years. (Mason and Wickman,1988). Outbreak densities

Figure III-3: Larval Web

have been measured as high as 300 – 600 caterpillars per 1000 sq. inches of foliage (equivalent to about 3- 18 inch branch tips). The primary host species are Douglas-fir, true fir and white fir. During outbreaks, the larvae have been known to defoliate ponderosa pines that are intermixed with the host species, snowberry, and even grass (Gregg, pers. comm.). Outbreaks collapse as quickly as they begin because of high densities, starvation, and disease.

Role of Douglas-fir Tussock Moth in the Environment

The Douglas-fir tussock moth is a native insect, and it acts as a natural disturbance agent when outbreaks occur. In many areas, the pattern of gradual stand dominance by Douglas-fir and/or true fir is a result of natural succession, lack of ground fires, or previous management practices. Outbreaks serve as one way to return parts of these areas to stand initiation (or early successional stages). Heavy defoliation and tree mortality (either directly from the defoliation or from secondary mortality from bark beetles) creates openings of various sizes – some are small, consisting of only a few acres, to others that can be quite large – 500 to 1,000 acres. These openings can result in increased patches of shrubs, grasses, and cover plants, (Youngblood and Wickman, in press); and allows the return of seral tree species such as ponderosa pine and larch (Wickman, et. al., 1986). Large, dead trees provide snags and wildlife habitat (Youngblood and Wickman, in press). The dead needles and frass from the feeding insects return high amounts of nutrients to the soil for the short term, and larger woody material provides a longer-term nutritional base.

Status of the Current Douglas-fir Tussock Moth Population

Scientists have developed sampling techniques to monitor DFTM populations as they fluctuate and to determine which of these fluctuations will lead to an outbreak. The Early Warning Trapping System uses a sex attractant to lure male moths into the trap. This method consists of a series of traps placed each fall in permanent sites throughout eastern Washington and Oregon. Douglas-fir tussock moth populations and fluctuations have been monitored for over 20 years with this trapping system. If the average number of male moths in a trap goes over 40, a second level of ground sampling (sampling larval and pupal/egg mass life stages) is initiated (see Appendix D for a more detailed description of sampling procedures and sequence). This increasing number of trap catches between 1997 and 1998 led the Forest Service to conclude that a Douglas-fir tussock moth outbreak was imminent. This has been confirmed in some areas by the larval and pupal/egg mass surveys, and the 1999 aerial detection survey picked up about 21,000 acres of Douglas-fir tussock moth defoliation on the Pine Ranger District of the Wallowa-Whitman National Forest. Additional light defoliation has been reported from ground observations on other portions of the Wallowa-Whitman and Umatilla National Forests. Although the increase in DFTM populations is well documented, the extent and exact locations of the outbreak cannot be predicted. The distribution of high trap counts throughout eastern Oregon and Washington indicates this outbreak will be more widespread than 1991 outbreak.

Plants

Colville National Forest

There are no known threatened, endangered, or proposed plants on the Forest. It is not in the Survey and Manage zone. There are 35 sensitive species documented or suspected to occur on the Forest. Several *Botrychiums* have been found but most are in cedar types or wetlands. *Cypripedium parviflorum* occurs in Douglas-fir host types.

Okanogan National Forest

There are no known threatened, endangered, or proposed plants on the Forest. There are no known sensitive plants in host type. Most of the Forest sensitive species are wind pollinated or pollinated by non-Lepidoptera insects. The mountain dandelion, *Agoseris elata,* is known to have a Lepidoptera pollinator but resides in meadows outside host type. There are several Survey and Manage species. Candy stick *(Allotropa virgata)* is a shade dependent species that lives (probably as a saprophyte) in the understory of Douglas-fir and true fir types. Most *Botrychiums* on this Forest occur in non-host type. The fungus *Bridgeporus nobilissimus* occurs in the noble fir zone but out of proposed protection areas. Survey and Manage lichens and most bryophytes are not in proposed protection zones. None of these species has Lepidopteran spore transmittal agents. It is doubtful that there are any Lepidopteran pollinators of *Allotropa virgata*.

Wenatchee National Forest

Ute ladies tresses (*Spiranthes diluvialis),* a federally threatened species are suspected to occur on the Wenatchee. The plant is known to occur on private land north of Okanogan but has not yet been found on the Wenatchee Forest. No information on local pollinators is available. Bumblebees are apparently required for successful pollination in Idaho and Montana (Ruesink, 1997). It is unlikely that this species requires a Lepidopteran for pollination. Wenatchee Mountain Checkermallow (*Sidalcea oregana calva)* is listed as federally endangered. It lives in wet meadows but could occupy forested habitats. Lepidopterans are known pollinators for this species. Showy Stickseed (*Hackelia venusta)* is proposed for listing as an endangered plant. IT is found in stressed Douglas-fir habitats on sandy soils at low elevations. The only known population of about 150 individuals occurs in the Tumwater Canyon Botanical Area. Low seed production and lack of genetic variation constitute an internal threat. Trampling by visitors, unstable slopes, fire suppression, and competition from noxious weeds have also been identified as threats. Pollinator biology is not well documented. Lepidopterans are not known to be essential pollinators of this plant.

Approximately 50 sensitive species are documented or suspected to occur on the Wenatchee National Forest. Half are believed to occur in DFTM host type. There are no Survey and Manage species on the Forest.

UMATILLA NATIONAL FOREST

There are no threatened, endangered, or proposed plants on the Umatilla Forest. Habitat for Ute ladies tresses is known to exist on the Washington side of the Forest but existence of the plant has not been documented. The Umatilla is not in the Survey and Manage zone. There are 35 sensitive plant species documented or suspected on the Forest. Species occurring in the Douglas-fir and true fir host types include *Cypripedium fasiculatum*, several *Botrychiums*, *Bolandra oregana*, and *Ranunculus populago*. *Cypripedium fasiculatum* is found in the understory of firs with at least 60% shade. *Bolandra oregana* is found on cliff faces in grand fir types. *Ranunculus populago* is a riparian species in host type.

WALLOWA-WHITMAN NATIONAL FOREST

A federally threatened species, McFarlane's four o'clock (*Mirabilis macfarlanei)* occurs on the Forest but is located in the grasslands of Hell's Canyon (non-host type). A recently proposed species, Spaulding's catchfly (*Silene spauldingii)* is a Palouse prairie resident that does occur on edges of Douglas fir types. *Howelia aquatilis* also occurs on the Forest but is not likely to occur in host type. The Wallowa-Whitman is not in the Survey and Manage zone.

There are 68 sensitive plants documented or suspected on the Wallowa-Whitman. Twelve *Botrychiums* and 20 other sensitive plants occur in DFTM host type. Information is lacking on Lepidopteran pollinators. However, one sensitive species of Leptodactylon has a known Lepidopteran pollinator. This species does not occur in potential protection areas. *Phlox multiflora* may also have a Lepidopteran pollinator.

MALHEUR NATIONAL FOREST

There are no threatened, endangered, or proposed plants on the Malheur Forest. The Forest is not in the Survey and Manage zone. There are 23 species of sensitive plants documented or suspected on the Malheur. Species occurring in or near host type include: *Thelypodium ucosomum* (in open sites), *Luina serpentina* (on steep rock outcrops adjacent to Douglas-fir forests), and *Phacelia minutissima* (in grand fir types). Lepidoptera pollinators are not currently known to be essential for any of these plant species.

OCHOCO NATIONAL FOREST

There are no threatened, endangered, or proposed plants on the Ochoco. Habitat suitable for Ute ladies tresses exists but no plants have been found. The Ochoco is not in the Survey and Manage Zone. There are 25 sensitive plant species. *Botrychiums* may occur in host type but that is not their primary habitat on the Ochoco. *Calochortus longebarbatus var. peckii*, live in meadows in the Douglas-fir zone and the Douglas-fir/grand fir types. However, because it is a sterile triploid, it is not pollinated. All of the sensitive species on the Ochoco are shade tolerant. *Cypripedium calceolus* is reported as occurring on the Forest but the taxonomy is not certain and it may be a color morph of the yellow orchid *C. montanum.*

WINEMA NATIONAL FOREST

There are no known threatened, endangered, or proposed plants on the Winema National Forest. *Spiranthes diluvialis* and *Howelia aquatilis* are found just outside Forest boundaries. One Survey and Manage species, *Cypripedium montanum*, occurs on Chiloquin Ridge primarily in coniferous understories with 50-60% shade. It is bee pollinated with no known Lepidopteran pollinators. There are also 10 sensitive plants documented or suspected to occur on the forest. Of these, only *Collomia mazama* and blue-leaved penstemon reside in DFTM host type.

FREMONT NATIONAL FOREST

There are 14 sensitive plant species on the Forest. Two occur in host type.

HUMAN ENVIRONMENT

HUMAN HEALTH

The health and safety of people are influenced by many factors including diet, climate, diseases, contaminants in the soil and water, emotional well-being, and access to medical facilities. This analysis concerns itself with the potential or perceived health effects associated with the Douglas-fir tussock moth and proposed actions. Human health effects include those effects related to the exposure and potential effects of treatment with insecticides, and the effects related to exposure to the Douglas-fir tussock moth.

Throughout the analysis area, there are many sites used by humans - recreation sites, resorts, camps, worksites, and small communities. People who live in or near areas where there are host type trees could be affected by the Douglas-fir tussock moth and people who live near proposed treatment areas could be exposed to the biological control agents. These people may include individuals with allergic reactions, respiratory ailments, or chemical sensitivities; immuno-compromised individuals, children, and the elderly. Individuals who work in the forest environment or with trees, who mix or apply the pesticides, or recreate within the forest could be exposed to the moth or the proposed treatments.

Recreation Sites

Recreation sites tend to have high levels of investment in infrastructure and services, leading to high losses in recreation value from the physical damage and nuisance effects of an insect outbreak. In particular, campgrounds, summer homes, camps, visitor centers, scenic vistas, and other places of concentrated recreation use are affected. Larvae and fecal pellets fall on picnic tables, cars, and tents. Sites that are especially unique, popular, or can accommodate more visitors suffer because comparable substitute sites are not available. The following is a summary of the high-use and high-risk recreation sites per Forest. A complete list for each Forest appears in Appendix J.

Colville = 12
Wenatchee = 27
W-W = 7
Ochoco = 16
Fremont = 0
Okanogan = 69
Umatilla = 31
Malheur = 16
Winema = 1

Residential & Administrative Sites

Residential and administrative sites include offices, work centers, residences, camps, resorts, and other places where people work and live within the boundaries of National Forest lands. These sites are prone to the same health and nuisance problems that afflict high use recreation sites. However, residential and administrative sites are generally permanent facilities that cannot be reasonably avoided in favor of alternate locations during a tussock moth outbreak. If unable to temporarily relocate or suspend occupancy, people can suffer from exposure to the insect or absorb a substantial loss or inconvenience by staying away. The following are the high-risk residential and administrative sites per Forest. A complete list for each Forest appears in Appendix J.

Colville = 0
Wenatchee = 7
W-W = 0
Ochoco = 4
Fremont = 0
Okanogan = 7
Umatilla = 15
Malheur = 1
Winema = 2

Municipal Watersheds

Four of the nine National Forests contain municipal watersheds that could be affected by a Douglas-fir tussock moth outbreak:

- **Umatilla**: Walla Walla watershed (Mill Creek)
- **Wallowa-Whitman**: Baker City and Sumpter City watersheds
- **Malheur**: Canyon City watershed (Byram Gulch)

Refer to the previous discussion on Water Quality, page III-13, for more information on water quality. One outcome from defoliation is buildup of fuels and increased risks from fire. Also, refer to the discussion on Fire, page III-9.

The issue of elevated fire risk in five municipal watersheds was raised during scoping and in comments to the draft Environmental Impact Statement. Table I-12 displays the areas within each municipal watershed that are categorized by the 20-60% and the 60-100% host types, as well as the total area of the watershed.

Currently, risk of fire is relatively high to very high for each of these watersheds and access in these watersheds is generally limited. There is a significant amount of host type within each watershed (from 47 to 61 percent of the National Forest land area within each watershed), increasing the probability of effect from an outbreak.

Table III-12: Host Type in Municipal Watersheds

Watershed	20- 60% Host Type[12] (% NF Area[13])	60-100% Host Type (% NF Area)	Watershed Area On National Forest Lands
Baker City and City of Sumpter Municipal Watersheds Wallowa-Whitman NF	3,984 (24%)	4,757 (29%)	16,424
Canyon City Municipal Watershed Malheur NF	45 (16%)	106 (38%)	279
City of Walla Walla Municipal Watershed Umatilla NF	1,817 (9%)	10,461 (52%)	20,268

[12], 20-50% host type for the Malheur NF only
[13] Percent of National Forest lands in the watershed with host type

SCENIC AREAS

Scenery is the general appearance of a place described in terms of line, color, texture, and form. Both "natural" appearing and cultural landscapes may be highly valued by the public. Scenery is a product of both natural processes and human-induced change, the latter having a major influence even on the naturally appearing landscapes characteristic of National Forest system lands. National Forests serve as visual backdrops for communities, residences, and recreation areas throughout eastern Oregon and Washington. People generally accept that landscape settings are dynamic and that visual settings change over time, though most people do not prefer drastic changes. Changes in scenic value are more apparent in foreground views than in middle ground or background views.

Foreground Views

Foreground view areas are designated in Forest Plans because of their high exposure to humans through either travel corridors or other areas of relatively high amount of recreational use. Five National Forests in eastern Oregon and Washington identified scenic foreground Areas of Concern that fell in host type for the Douglas-fir tussock moth, and that warranted protection from the tussock moth.

The National Forests in eastern Oregon and Washington identified foreground areas that fell in host type for the Douglas-fir tussock moth and that could be degraded by defoliation. The visual impact from tussock moth damage is usually greatest in campgrounds and other recreation sites where the loss of even a few trees can make a noticeable difference. However, views along popular travel corridors or from communities near National Forest boundaries can also be significantly affected.

The highest visual impact from tussock moth damage would likely be in stands composed of from 60 to 100 % host type species. In these stands, heavy damage to trees usually occurs in patches of from several acres to several hundred acres in size. In the outbreak of 1972 / 1973, about 12% of the area consisted of areas of either 100% mortality or over half the trees totally defoliated. In the latter case, 75% tree mortality resulted. About 40% of the area resulted in half the trees being over one quarter defoliated from the top down. In this case, about 10% tree mortality occurred (USDA Forest Service, 1974). Uniform and contiguous defoliation would most likely occur in areas consisting of predominant host type species and with multiple canopy layers. Visual impact will be most evident when trees have the obvious red appearance of defoliation during the years that the outbreak is occurring. Research on one outbreak found that half the severely defoliated trees that survived appeared normal within two years and 98% appeared normal within ten years.

The following table shows the extent of risk for defoliation in the scenic Areas of Concern identified by the forests. High risk and to some extent, medium risk, would likely be areas of greatest potential impact to visual quality. Low risk would not likely result in noticeable degradation. High-risk areas are generally composed of mostly 60-100% host type. Medium-risk area also contain large portions of 60-100% host type which could, if defoliated, result in a noticeable visual impact to many.

Table III-13: Acres in Foreground Scenic Areas

FOREST	LOW RISK	MEDIUM RISK	HIGH RISK
Okanogan	43,450	42,990	4,680
Wenatchee	970	2,930	940
Umatilla	11,600	41,720	13,920
Malheur	12,090	20,010	1,530
Ochoco	3,930	3,060	650
Total	**72,040**	**110,710**	**21,720**

Background Views

Distant view areas, consisting of middle and 'backdrop' views, were not among those areas initially identified for protection in the Purpose and Need. The inclusion of these areas in the analysis stemmed from public comment that sought better protection of current forest conditions. Forest Plans designated categories of "middle-ground" and background scenic areas. Generally, these landscapes are large and absorb modest changes without harm to scenic values. As travelers get closer to these views, the features become more apparent and changes in vegetation are more noticeable. Backdrop views should not be diminished by tree defoliation and mortality from tussock moth. Still, tussock moth damage would be evident to local viewers, especially in the short term. Since specific distant view areas were not identified for this plan, effects are estimated to be proportional to the number of acres of host type in three risk classes on each National Forest. The more acres and the higher the risk, the more likely backdrop scenic areas would be negatively affected by tussock moth.

CHAPTER IV: EFFECTS ANALYSIS

SUMMARY OF CHANGES BETWEEN DRAFT AND FINAL

Reorganized discussion of effects.

Clarified and expanded the discussion of effects regarding project issues.

Added or clarified specific discussions on threatened, endangered, proposed, sensitive, Survey and Manage, and other wildlife and plants.

Clarified and expanded the discussion of effects of tussock moth outbreaks.

Clarified and expanded the discussion of effects on non-target Lepidoptera.

Clarified and expanded the discussion of effects on wildlife that eat moths and butterflies.

INTRODUCTION

This chapter provides the scientific and analytical basis for the comparison of alternatives displayed in Chapter II. It discusses the direct, indirect, and cumulative environmental effects of the Proposed Action and all alternatives. Environmental affects result when changes are made to ecosystems. Changes may occur either by implementing an action or by choosing to exclude all or some areas from action. Information that is more detailed can be found in the analysis file, available upon request.

FOREST HEALTH

All of the alternatives considered would leave some host type unprotected. In host type stands that are not protected during a tussock moth outbreak, varying levels of defoliation and mortality would be expected. This would depend on physical factors (elevation and aspect), and biological factors (amount of host type, stand structure, tussock moth reproduction and bark beetle activity). Insect outbreaks are generally defined as “minor disturbances”, in the sense that some trees remain alive. This distinguishes them from "major disturbances", such as glaciers or severe stand replacing fires (Oliver and Larson 1990).

Experience from the 1972/1973 Outbreak

In the early 1970s outbreak, about 700,000 acres were defoliated to some degree by Douglas-fir tussock moth. The severity of defoliation varied from light to heavy with tracts of up to 1000 acres of 100% dead trees. The degree of defoliation was surveyed and classified as follows (USDA Forest Service, 1974):

- Dead – 100% mortality. This occurred in areas of up to several hundred acres in size. This category included about 17,490 acres.
- Severe defoliation – over 50% of the area had trees with 100% defoliation. These areas had about 75% mortality. This category included about 62,800 acres.
- Moderate defoliation – over 50% of the area had trees with at least the top quarter of the crown completely defoliated. These areas had about 10% mortality and included about 279,820 acres.
- Light defoliation – this had two parts, the first where the defoliation was visible from the air and had less than a quarter of the crowns defoliated and the second where defoliation was not visible from the air. In these areas, mortality was scattered, but was close to zero percent.

Current Predictions

If the outbreak proceeds as expected, unprotected areas would have various levels of change in stand structure, stand density, and species composition. These changes would be most pronounced in high-risk stands with 60-100% host type and dense or medium crown closure. In the short term, defoliation could reduce crown closure below 20%. Some defoliated trees would recover. Mortality could reduce crown closure by an average of one class until sites reforested and reestablished crown closure (dense crown closure would be reduced to medium and medium would be reduced to low). There would be a corresponding increase in the number of snags, which could be beneficial to snag-dependent wildlife. For purposes of this analysis, estimates of defoliation and mortality for moderate-risk sites are considerably lower than estimates for high-risk sites. However, in 60-100% host type, moderate-risk sites with dense crown closure could also experience substantial defoliation if the outbreak becomes severe.

Stands that experience heavy mortality in host species and that have adequate pine seed source would have more pine regeneration. In the absence of ground fire or silvicultural treatment, true fir and Douglas-fir would remain the dominant tree species in most stands (Wickman, et. al., 1986). As snags fall, increasing fuel loads could make the area subject to stand-replacing wildfire.

Host trees that survive defoliation would experience several years of reduced growth, followed by long term growth increases (Wickman and Starr, 1990).

NO ACTION

No stands would be protected from tussock moth defoliation. Varying levels of defoliation and mortality would be expected. The acres of host type by risk rating and crown closure for each Forest were displayed in Chapter III. Stands with dense crown closure and a high risk of outbreak are generally dry, overstocked sites, with low vigor and high susceptibility to a variety of forest pests and pathogens. The highest mortality and most pronounced changes in structure would occur in these stands.

Figure IV-1: Effects of Defoliation

High Risk Stands

Defoliation of 60-100% is expected, with 25 - 95% direct mortality (average = 48%). Mortality would take place over the duration of the outbreak. Bark beetles would be attracted to trees stressed by defoliation. Douglas-fir beetles would attack Douglas-fir, fir engravers would attack grand fir, and western balsam bark beetles would attack subalpine fir. Bark beetle mortality would probably continue for three years after tussock moth mortality (Wickman, 1963). If bark beetles are already active in the area, total mortality in trees larger than 14" dbh could average 70%. Smaller trees, less attractive to bark beetles, would have average mortality of 50%. This could create a late stand initiation stage, where growing space is not fully occupied and new stems become established in openings.

Where bark beetles are not already active, beetles would be attracted to the area. Total mortality would probably increase to 61% for trees larger than 14" dbh and 22% for smaller trees. Although total mortality would be less than in active bark beetle areas, it would still create sufficient openings to develop late stand initiation stage conditions.

Moderate-Risk Stands

Expected defoliation is 40-60% of host species, with 5% direct mortality in trees of all size classes. If bark beetles are already active in the area, total mortality in trees larger than 14" dbh would average 25%; 7% in smaller trees. In addition to mortality, the tops of 10-25% of the host trees would die. In 60-100% host type stands, the combined effects of direct and indirect mortality could be sufficient to move some stands to a late stand initiation stage. Where bark beetles are not already active, some bark beetle mortality is still expected. Total mortality in trees larger than 14" dbh would average 12%. There would be little/no additional mortality in smaller trees. Ongoing stand dynamics would probably not be affected. In 20-60% host type stands, even the highest expected level of mortality would not have a substantial effect on stand dynamics.

Low-Risk Stands

Defoliation in low risk stands would probably be 10-40%, with little mortality unless bark beetles are active in the area. No change in stand dynamics is expected.

Cumulataive Effects: The 1997 Interior Columbia Basin Ecosystem Management Project Draft EIS included recommendations for management of dry site forests. National Forests east of the Cascades have used these recommendations to design projects on dry sites. The Wenatchee, Wallowa-Whitman, and Umatilla Forests have developed specific strategies for restoration of dry sites. The Wenatchee's Dry Site Strategy sets Forest-wide priorities for thinning, under-burning, and harvest designed to improve forest health and sustainability. The Blue Mountain Demonstration Project on the Wallowa-Whitman and Umatilla National Forests is a 2.5 million acre watershed-level project. Activities would include thinning and prescribed fire to improve the health of dry sites. Because of the substantial mortality likely to occur from the No Action Alternative, some of those other restoration strategies could be rescheduled or changed. More detail can be found in the Forest Health section of the analysis file.

The Colville, Okanogan, and Wenatchee National Forests have 84,000 acres of dense, high-risk host type. Most of this is on the east half of the Colville National Forest. If a tussock moth outbreak occurs here, additional mortality from the existing Douglas-fir beetle outbreak is expected.

There are 2,731,100 acres of host type; heavy defoliation could occur on high- and medium-risk sites. About 308,100 acres are considered high-risk, with dense crown closures of more than 60% host species. About 40,000 acres had visible tussock moth defoliation in 1999 and surveys indicate that populations are continuing to build. Tussock moth populations in eastern Oregon are volatile and the likelihood of outbreak is higher here than anywhere else in the Region (Mason, 1996).

The Winema and Fremont National Forests have a relatively small amount of dense, high-risk host type. Stands are concentrated on the west side of the Winema, near Mountain Lakes and Sky Lakes Wilderness Areas.

PROPOSED ACTION

The Proposed Action would protect areas where loss of crown cover and associated mortality could cause a loss of valuable resources. High-risk stands that are protected would continue to decline in vigor due to overstocking. Susceptibility to defoliating insects, bark beetles, and root diseases would remain high unless stocking control and species composition is changed with silvicultural treatment (Wickman, 1986). Moderate risk stands that are protected would generally maintain current rates of growth and development. Some low risk stands would be protected from defoliation to maintain crown closure in those areas. Short-term protection from defoliation would have little effect on overall stand health or development.

Cumulative Effects: Implementation of the Proposed Action would retain existing host type vegetation on about 236,000 acres of high-risk, dry forest where defoliation could result in damage to Areas of Concern. Retaining host type on these acres would be a short-term strategy until restoration efforts could be implemented. Where substantial defoliation and mortality occurs, restoration efforts might have to be rescheduled in response to changes in stand structure and fuel load.

COLVILLE, OKANOGAN, AND WENATCHEE FORESTS

There are 1,291,400 acres of host type in eastern Washington, of which 84,000 acres are dry site forests at high risk for defoliation and mortality. If the Proposed Action were implemented, 65,600 of these dry site acres would not be protected.

On the Colville National Forest, 7,200 acres would be protected from defoliation. This includes 900 acres of dry site, dense forest. All of these are high-use recreation or residential areas, including the City of Ione, Sullivan Lake,

Swan Lake Recreation Enclave, and several other campgrounds.

On the Okanogan National Forest, about 122,000 acres would be protected. This includes 7,600 acres of dry site, dense forest. Protection areas are scenic highway corridors, late/old stand structures with important habitat values, and Wilderness areas and Late Successional Reserves that are at high risk of wildfire.

On the Wenatchee National Forest, about 95,600 acres would be protected from defoliation, including 9,900 acres of dry site, dense forest. Most of this is spotted owl nesting, roosting or foraging habitat.

UMATILLA, W-W, MALHEUR, AND OCHOCO FORESTS

In the event of an outbreak, 389,100 acres would be protected from defoliation. This includes 97,300 acres of dry site, dense forest. 210,800 acres of high-risk dry sites would not be protected. In addition, 1,424,900 acres of medium-risk sites and 407,800 acres of low-risk sites would be unprotected.

On the Umatilla National Forest, 135,300 acres would be protected from defoliation, including 53,000 acres of dry site, dense forest. These areas are important late/old structure habitats and high use recreation sites.

On the Wallowa-Whitman National Forest, 110,600 acres would be protected from defoliation, including 31,500 acres of dry site, dense forest. These areas are important late/old structure habitats and high use recreation sites. They also include two municipal watersheds

On the Malheur National Forest, 73,300 acres would be protected from defoliation, including 5,800 acres of dry site, dense forest. These areas are important late/old structure habitats, fish streams, and scenic viewsheds.

On the Ochoco National Forest, 69,900 acres would be protected from defoliation, including 7,000 acres of dry site, dense forest. These areas are important late/old structure habitats, fish streams, high use recreation sites, and scenic viewsheds.

WINEMA AND FREMONT NATIONAL FORESTS

On the Winema National Forest, 24,600 acres would be protected from defoliation. Very little of this is on dry site, dense forest. The habitat of a rare alga, a 600 acre block around Mare's Egg Spring, and 24,000 acres of spotted owl habitat in the Chiloquin Ridge area would be protected.

On the Fremont National Forest, one bull trout reach (200 acres) would be protected if an outbreak occurs. This site would experience no change in current stand structure, growth rate, or overall forest health. Of the remaining 11,600 acres, all are considered moderate to low risk for defoliation because crown closures are less than 70%. Although defoliation risk is not high, up to 4,200 acres of stands dominated by host type could have mortality of 5-10%, with an additional 10-25% of the trees top-killed. This is a higher mortality rate than would occur under normal levels of insect and disease, but it would not affect succession or overall forest health. If defoliation occurs in mixed species stands, mortality would be only 1-2%. This is the same or slightly higher than expected under normal insect and disease levels. Overall, forest health and succession would not be affected.

EXPANDED PROTECTION ALTERNATIVE

In addition to areas considered in the Proposed Action, all 60-100% host type outside Wilderness would be protected to prevent defoliation. Dense host type forests on dry sites could continue to experience declining vigor. Susceptibility to defoliating insects, bark beetles, and root diseases would remain high. One of these disturbance agents or wildfire would eventually remove most host type, could reduce short term crown closure, and could result in regeneration of both host and non-host species (Wickman, et. al.,1986). Non-host species are mostly early seral, such as ponderosa pine and larch. These might increase after the outbreak. However, unless measures are taken to reduce stocking of naturally-regenerated host species, tussock moth host species would eventually out compete pines and larches, starting the cycle over again.

Cumulative Effects: Protection could prevent defoliation of overstocked dry sites. Planned restoration projects could proceed. No changes in scheduling or emphasis would be required due to defoliation and mortality.

TM-BIOCONTROL ONLY

The effects of TM-BioControl Only alternative would be similar to the Proposed Action. In the unlikely event that an outbreak occurred on every acre identified for protection, existing supplies of the insecticide would be used to protect the highest priority sites. Up to 262,000 acres of lower priority scenic view and late/old structure could be defoliated.

FOREST ENVIRONMENT: LATE SUCCESSIONAL RESERVES

NO ACTION

EASTERN WASHINGTON CASCADES PROVINCE

No host type stands would be protected from defoliation. In the event of an outbreak, there would be a potential for heavy defoliation and mortality in Upper Methow, Nice, Twisp River and Sawtooth LSRs on the Okanogan, and Lucerne, Shady Pass, Chiwawa, Natapoc, Deadhorse, Eagle, Boundary Butte, Sand Creek, Swauk, and Teanaway LSR/MLSRs on the Wenatchee. This could include most of the late/old structure in the Nice and Twisp River LSRs, and about half of the late/old structure in Teanaway LSR. Areas of heavy mortality would lose their old growth character, and would enter a stand initiation stage. The additional fuel load would increase the risk of stand-replacing wildfire.

If severe defoliation occurs in areas of 20-60% host type, there would be reduced inter-tree competition. As a result, non-host species could have increased growth.

YAKIMA PROVINCE

There would be a potential for heavy defoliation and mortality in the Manastash LSR, which has substantial acreage of 60-100% host type. Most of this would be in the moist grand fir plant community. Risk of outbreak is moderate in this community type, but under outbreak conditions, there can be substantial damage to host trees. These acres could lose their late/old structure, and enter a stand initiation stage.

EASTERN OREGON CASCADES PROVINCE

No host type stands would be protected from defoliation. In the event of an outbreak, there would be a potential for heavy defoliation and areas of mortality in LSRs 227, 228 and 229 on 35,000 acres. This could include most of the old growth in LSRs 227 and 228, about 17,000 acres. Areas of heavy mortality would lose their old growth character, and would enter a stand initiation stage. The additional fuel load would increase the risk of stand-replacing wildfire.

An additional 16,000 acres with 20-60% host type could have defoliation and mortality. These stands would have reduced inter-tree competition, and non-host species would have increased growth.

PROPOSED ACTION AND TM-BIOCONTROL ONLY ALTERNATIVE

EASTERN WASHINGTON CASCADES PROVINCE

Some of the host type stands in Upper Methow, Nice, Twisp River, Sawtooth, Chiwawa, Boundary Butte, and Teanaway would be protected from defoliation. All of the host type stands in Lucerne, Shady Pass, Natapoc, Deadhorse, Eagle, Sand Creek, and Swauk would be protected. These areas would have no change in stand dynamics because of defoliation. There could be substantial losses of late/old structure in the Sawtooth and Teanaway LSRs, where several thousand acres of 60-100% host type would not be protected. Protected areas in the dry plant association groups would continue to decline in vigor unless silvicultural treatments are implemented.

Table IV-1: E. WA Cascades Province - Protection Summ. for Proposed Action & TM-BioControl Alt.

NAME	LATE/OLD PROTECTED 60-100%	LATE/OLD NOT PROTECTED 60-100%	LATE/OLD PROTECTED 20-60%	LATE/OLD NOT PROTECTED 20-60%	YOUNG TO MATURE PROTECTED 60-100%	YOUNG TO MATURE NOT PROTECTED 60-100%	YOUNG TO MATURE PROTECTED 20-60%	YOUNG TO MATURE NOT PROTECTED 20-60%
Boundary Butte	100	100	300	600	0	100	100	400
Chiwawa	2,200	300	2,800	600	2,400	200	2,200	400
Nice	400	200	400	100	600	200	500	100
Sawtooth	900	3,200	300	2,500	2,100	6,400	900	3,600
Teanaway	2,700	6,500	0	0	0	0	0	0
Twisp River	3,700	1,000	2,500	400	7,600	1,900	4,700	700
Upper Methow	5,900	5,600	2,500	800	10,300	10,000	4,200	1,400

Table IV-2: Yakima Province - Protection Summary for Proposed Action or TM-BioControl Alternatives

NAME	LATE/OLD PROTECTED 60-100%	LATE/OLD NOT PROTECTED 60-100%	LATE/OLD PROTECTED 20-60%	LATE/OLD NOT PROTECTED 20-60%	YOUNG TO MATURE PROTECTED 60-100%	YOUNG TO MATURE NOT PROTECTED 60-100%	YOUNG TO MATURE PROTECTED 20-60%	YOUNG TO MATURE NOT PROTECTED 20-60%
Haystack	1,700	0	3,600	0	500	0	600	0
Lost Lake	200	0	2,100	0	0	0	500	0
Manastash	3,800	12,100	0	0	0	0	200	0
Russell Ridge	1,100	0	700	0	200	0	300	0
Tieton	100	100	100	100	0	0	0	0

YAKIMA PROVINCE

Some of the host type stands in the Manastash and Tieton LSRs would be protected from defoliation. All of the host type stands in the Haystack, Russell Ridge and Lost Lake MLSRs would be protected. These areas would have no change in stand dynamics because of defoliation. About 12,100 acres of 60-100% host type, the late/old structure in the Manastash LSR, would not be protected and could enter the stand initiation stage.

EASTERN OREGON CASCADES PROVINCE

The effects are the same as the No Action alternative.

EXPANDED PROTECTION ALTERNATIVE

EASTERN WASHINGTON CASCADES PROVINCE

In addition to areas protected under the Proposed Action, all areas of 60-100% host type would be protected from defoliation. There would be no losses of late/old structure or changes in stand dynamics due to defoliation. Protected areas in the dry plant association groups would continue to decline in vigor unless silvicultural treatments are implemented.

YAKIMA PROVINCE

All areas of 60-100% host type would be protected from defoliation. There would be no losses of late/old structure due to defoliation, and no changes in stand dynamics.

EASTERN OREGON CASCADES PROVINCE

All host type stands with 60-100% host type would be protected. There would be no changes in structure, old growth character, or wildfire risk because of defoliation.

FOREST ENVIRONMENT: OLD-GROWTH/LOS

NO ACTION

High-risk areas with dense crown closure and 60-100% host type could have the most dramatic changes in stand structure. In the event of an outbreak, these areas are likely to be heavily defoliated with significant mortality. Late/old structure could be lost and the stands could enter the late stand initiation stage. If outbreak conditions are severe, old growth function could be at risk wherever tussock moth host species are dominant. Risk of stand-replacing fire would be very high during the year(s) of defoliation. Where defoliation results in mortality, long term fire risk would increase. Fire spread could result in the loss of adjacent late/old structures, even those without severe insect mortality. On some Forests, there could be sudden, substantial increase in fuels. Stands of less than 60% host type could have reduced crown closure and changes in structure, but old growth function would probably not be lost.

COLVILLE, OKANOGAN, AND WENATCHEE FORESTS

On the Colville, 5% of the Forest's old growth would probably lose function due to defoliation and mortality. Another 60% is dominated by host type, and could be at risk to lose old growth function in a severe outbreak. These changes would be most evident on the west half of the Forest.

On the Okanogan, 3% of the Forest's old growth would probably lose function due to defoliation and mortality. All of this is in Late Successional Reserves. Another 30% is dominated by host type and would be at risk to lose old growth function in a severe outbreak. This includes 10 spotted owl activity centers.

On the Wenatchee, less than 1% of the Forest's old growth would probably lose function due to defoliation and mortality. Another 2% is dominated by host type, at risk to lose old growth function in a severe outbreak. Although this is a small portion of the Forest's total old growth, it includes 20 spotted owl activity centers.

UMATILLA, W-W, MALHEUR, AND OCHOCO FORESTS

Historic information and current insect surveys indicate the highest tussock moth populations are, and will continue to be, in eastern Oregon.

On the Umatilla, 25% of the Forest's old growth would probably lose function due to defoliation and mortality. This would include portions of the single largest contiguous stand of old growth on the Forest. Another 30% is dominated by host type, at risk to lose old growth function in a severe outbreak.

On the Wallowa-Whitman, 10% of the Forest's old growth would probably lose function due to defoliation and mortality. Another 30% is dominated by host type, at risk

to lose old growth function in a severe outbreak. Stands throughout the Forest could be affected.

On the Malheur, 7% of the Forest's old growth would probably lose function due to defoliation and mortality. Another 50% is dominated by host type and would be at risk to lose old growth function in a severe outbreak. This could include stands throughout all old growth habitat areas.

On the Ochoco, 10% of the Forest's old growth would probably lose function due to defoliation and mortality. Another 30% is dominated by host type, at risk to lose old growth function in a severe outbreak. This could cause noticeable changes in old growth distribution throughout the Forest since the north half would be most severely affected.

WINEMA AND FREMONT NATIONAL FORESTS

On the Winema, 6% of the Forest's old growth would probably lose function due to defoliation and mortality. All of this is in Late Successional Reserves. Another 10% is dominated by host type, at risk to lose old growth function in a severe outbreak. There is no old growth at risk for tussock moth defoliation on the Fremont.

PROPOSED ACTION

Each Forest has identified areas where defoliation or mortality would substantially degrade one or more resource values. The Proposed Action includes protection of some late/old structure on every Forest as part of these Areas of Concern.

Some potentially protected stands are "high risk", with multi-storied structure and dense crown closure. These are generally overstocked, dry sites. Vigor would continue to decline on these sites. Defoliation in unprotected stands, including OG/LOS, could result in vegetation changes. These areas would probably not lose old growth function, even with some mortality. Stands with a low percentage of host type could also be protected because they are surrounded by areas dominated by host type and it is impractical to avoid them.

COLVILLE, OKANOGAN, AND WENATCHEE NATIONAL FORESTS

On the Colville, 118,500 acres of old growth are dominated by host type, with 8,600 at high risk for loss of function. This includes 7,000 acres in the Salmo-Priest Wilderness. These areas are not presently providing unique habitat, or habitat for threatened or endangered species. None of these acres would be protected from defoliation. If maximum defoliation were to occur, 48,400 acres of non-host old growth and 8,800 acres of mixed species old growth would retain function. Potential effects would be the same as the No Action Alternative.

On the Okanogan, 65,700 acres of old growth are dominated by host type, with 6,000 at high risk for loss of function. Thirty percent of these acres would be protected from defoliation, including 2,600 acres at high risk for loss of function. An additional 8,200 acres of 20-60% host type would be protected. Most of these areas are in Late Successional Reserves and are providing important old growth habitat. Where host type is 60-100%, protection areas were identified based on need to prevent large-scale fire. In the Pasayten Wilderness, 1,200 acres would not be protected.

On the Wenatchee, 15,800 acres of old growth are dominated by host type, with 3,500 at high risk for loss of function. Sixty percent of these acres would be protected from defoliation, including all acres at high risk for loss of function. An additional 13,000 acres of 20-60% host type would be protected. All of these areas are in Late Successional Reserves. They are providing important old growth habitat and are at high risk for wildfire. Old growth that would not be protected includes 2,300 acres in Wilderness areas, mostly in Lake Chelan-Sawtooth.

UMATILLA, WALLOWA-WHITMAN, MALHEUR, AND OCHOCO NATIONAL FORESTS

On the Umatilla, 18,300 acres of old growth are dominated by host type, with 8,300 at high risk for loss of function. Eighty percent of these acres would be protected from defoliation, including all of the acres at high risk for loss of function. An additional 4,000 acres of 20-60% host type would be protected. These areas contain important habitat for fish and old growth dependent wildlife. Old growth that would not be protected includes 1,300 acres in the Wenaha-Tucannon Wilderness.

On the Wallowa-Whitman, 210,700 acres of old growth are dominated by host type, with 51,300 acres at high risk for loss of function. One-third would be protected to prevent degradation of fish habitat, raptor nest sites, scenic corridors, and the Baker City and City of Sumpter municipal watersheds. This would include 12,300 acres at high risk for loss of function. An additional 32,800 acres of 20-60% host type would be protected to preserve recreation values. Old growth that would not be protected includes 133,200 acres in Wilderness areas, primarily Hells Canyon and Eagle Cap.

On the Malheur, 149,100 acres of old growth are dominated by host type, with 18,300 at high risk for loss of function. Twenty percent of these acres would be protected from defoliation, including 5,000 acres at high risk for loss of function. An additional 8,700 acres of 20-60% host type would be protected. All of these are in unique habitat areas (see Chapter III). Old growth that would not be protected includes 13,200 acres in the Strawberry Mountain and the Monument Rock Wilderness Areas.

On the Ochoco, 31,700 acres of old growth are dominated by host type, with 7,700 at high risk for loss of function. Ninety percent of these acres would be protected from defoliation, including 7,000 acres at high risk for loss of function. An additional 34,400 acres of 20-60% host type would be protected. This would include stands containing residential and administrative sites, high use recreation areas, and the Mitchell municipal watershed. Old growth

that would not be protected is in Mill Creek, Bridge Creek, or Black Canyon Wilderness Areas.

WINEMA AND FREMONT NATIONAL FORESTS

On the Winema, 38,400 acres of old growth are dominated by host type, with 14,500 at high risk for loss of function. These areas are in the Sky Lakes and Mountain Lakes Wildernesses; they would not be protected. Most of these areas would not be protected. About 8,700 acres of 20-60% host type would be protected to prevent degradation of spotted owl activity centers.

There is no old growth at risk of defoliation on the Fremont; no OG/LOS stands would be protected.

EXPANDED PROTECTION ALTERNATIVE

In addition to areas identified under the Proposed Action, all late/old structure outside of Wilderness with 60-100% host type would be protected from defoliation. Stand dynamics would not change because of tussock moth defoliation.

TM-BIOCONTROL ONLY ALTERNATIVE

Potential effects are the same as the Proposed Action.

FIRE

Long-term fuel increase and subsequent changes in fire intensity and severity could result from a tussock moth outbreak. Fire behavior is based on stand density, stand composition, the amount and arrangement of surface fuels, moisture content, prevailing weather, and physical setting. Fire severity partly depends on fire behavior, varying by the duration of burning, the season, and site or stand conditions.

Tussock moth outbreaks can increase fire hazard in several ways. Large quantities of fine, dead fuels remain in tree crowns for several months to two years after defoliation. Other small diameter fuels can remain in the crowns for five years (Beukema, et. al., 1999). The effect on susceptibility of trees to crown fires is uncertain since crown mass decreases with defoliation (Agee, 1996) but the ratio of dead to live fuels increases (Zimmerman, pers. comm., 2000). Crown moisture, which can be much lower for dead foliage than live needles, influences the threshold at which crown fires can occur (Van Wagner, 1977).

The amount and distribution of surface fuel affects crown fire potential and the spread and intensity of surface fires. Surface fire hazard and the probability of crown fires increase when there is an accelerated build-up of fuels (i.e., needles, twigs, branches, and broken tops). Initially, a large amount of smaller diameter material from defoliated crowns becomes potential fuel. Larger diameter fuels (e.g., limbs over 3" in diameter) accumulate as surface fuel for about 15 years. The quantity and composition of surface fuels depends on the rate the materials fall from the dead trees, the decomposition rate, successional patterns of understory vegetation, species composition of the overstory, and previous history of the stand. With this accumulation of dead fuel, the increase in downed woody material far exceeds decay for several decades. After 10 to 15 years, surface fires could climb into the crowns of affected stands that have large amounts of downed material and fuel ladders.

The open canopies caused by defoliation also result in warmer, drier microclimates at the surface during daylight hours. Defoliated trees permit increased sunlight at the forest floor and higher wind speeds. Eventually, the opened canopy would foster the growth of sunlight-dependent shrubs, herbs, forbs, and grasses. This new growth on the forest floor could retard fire spread when the vegetation was moist. However, under drought conditions, the new growth could become an additional fuel, increasing the spread and intensity of a fire. Since these stands would have more grass and brush than a denser stand, spread rates might resemble a grass or brush fuel type. Predicted changes in fire behavior (Table IV-3, below) were derived using the BEHAVE model. Weather and fuel moisture conditions were kept constant to demonstrate the effects of changing fuel conditions (i.e., varying fuel models due to defoliation). Two sets of values were used for calculations. The first set represents fuel conditions commonly found during normal summers in the inland Northwest and the second set represents fuel conditions commonly found during drought conditions (NWCG, 1992). Not surprisingly, differences between fuel models are more pronounced during drought conditions.

Table IV-3: Fire Behavior

FUEL MODEL	RATE OF SPREAD NORMAL/DROUGHT (FEET/HOUR)	FLAME LENGTH NORMAL/DROUGHT (IN FEET)
2 - Short grass/Pine	1,650 / 1,112	5.3 / 6.3
5 - Deciduous brush	726 / 1,782	3.4 / 6.7
6 - Sagebrush/litter	1,848 / 2,244	5.6 / 6.4
8 - Short needle conifer litter	132 / 132	1.0 / 1.2
10 - Heavy short needle conifer litter	462 / 660	4.5 / 5.7
11 - Light slash	396 / 462	.4 / 3.7
12 - Medium slash	858 / 990	7.9 / 9.0

Snags from defoliated trees might persist for several decades. The presence of snags and large branches would probably affect fire severity and the duration of burning, not fire intensity. Larger materials require a much longer period of fire, which in turn, allows more heating of residual trees and the soil. The increased amount of fuel puts these areas at risk for uncharacteristic fire severity, which can lead to loss of organic matter, woody material, and nutrient reservoirs. This is especially true in drier environments where fire frequency is high (Harvey, et. al., 1994). Nutrients, such as nitrogen, can be evaporated by fire. This can result in an immediate loss of soil productivity and can limit future inputs of nutrients. Nutrients, such as carbon, become more available by fire,

by converting large woody debris into smaller, more readily decomposed material (DeBano, 1981, cited in USDA & USDI, 2000).

Refer to the Forest Health effects section for a description of defoliation categories of the early 1970's outbreak and an estimated acres of defoliation based on that outbreak. During that outbreak, about 700,000 acres were defoliated by Doug-fir tussock moth.

Table IV-4 is derived from the early 1970s outbreak experience.

The dead and severe defoliation categories generally result in the highest increase in fuels with a corresponding increase in the risk of ignition and rate of spread. Moderate defoliation would increase fuels significantly and would be more likely to carry a crown fire than severe defoliation. Light defoliation contribution to fuels and risk is minimal.

Defoliation in 1973 was in widely scattered clusters, a pattern expected in future outbreaks. The spatial distribution of the intensity of the outbreak, however, cannot be predicted. The actual location of the defoliation would be vital in determining the potential impact on forest stand structure and dynamics, and hence on altering the level of fire risk. If heavily impacted stands were distributed evenly throughout the total outbreak area, the overall impact on fire risk would be relatively small. Impacts at the stand level could be rather significant, as discussed above. However, maps of the 1970s outbreak reveal larger patches of heavy damage evident at the landscape scale, rather than at the stand scale. Some large patches that affected watersheds were close to numerous other large patches. These affected broad landscapes and sub-basins. Wildfires in these patches could become very large due to the additional fuel accumulations from defoliation, stand density, changes in microclimate (i.e., increased exposure to sun and wind). The majority of large fires in these Forests over the past two decades have occurred as multiple, high-intensity events. In the Blue Mountains, 44% burned at a high level of severity, compared to only 5% in the previous century (Johnson, 1998). Defoliation of extensive forest areas by Douglas-fir tussock moth could exacerbate the already significant challenge of reducing fuels and restoring ecosystems on a landscape scale.

No Action Alternative

This alternative would result in the highest fuel increase during the next 15 years. Based on the early 1970's outbreak experience, we could expect the most severe defoliation (and fuel buildup) on about 12 % of the outbreak area. About 40% of that area would have moderate defoliation. Surface fuel increases could affect fire intensity for two decades; effects of increases in ladder fuels would continue longer. Fire severity would increase for several decades or until the first severe fire.

Proposed Action and TM-BioControl Only Alternative

The Proposed Action and TM-BioControl alternatives would protect about 15% of the acres of the area in the No Action Alternative (the No Action alternative consists of areas between 20% and 100% host type) and would likely reduce overall severe and moderate defoliation proportionately. The key is that the specific identified areas as described in the Proposed Action (T&E habitat, Municipal Watersheds, Old Growth and Late Old Structure areas, etc.) would be protected with a subsequent prevention of increased fire risk in those areas.

Expanded Protection Alternative

This alternative would protect more than half of all host type, and nearly all of the 60-100% host type. The would prevent an increase in fuels and fire risks.

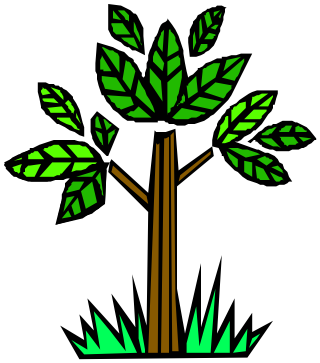
Table IV-4: Summary of Expected Defoliation, in acres

Alternative	100% Mortality	Severe Defol.	Mod. Defol.	Light Defol.	Total
No Action	17,490	0	0	0	17,490
Proposed Action & TM-BioControl Only	13,880	0	0	0	13,880
Expanded Protection	5,270	0	0	0	5,270

SEED ORCHARDS

NO ACTION

ALL FORESTS



None of the orchards would be protected. Although small Douglas-fir trees are less susceptible to bark beetles than large trees, they generally suffer more mortality from the direct effects of defoliation (Wickman, 1963). The exception is small seedlings with no overstory, which lacks tussock moth habitat (4 orchards on the Wallowa-Whitman). All other Douglas-fir orchards are susceptible. Defoliated orchard trees would probably have average mortality of 48%. This would necessitate replanting – a considerable expense plus the loss of years already invested in growing the trees.

These seed orchards were established to provide a source of seed from parent trees known to be vigorous under local conditions. The parent trees grew more rapidly than their neighbors, had good form, and produced seedlings with good juvenile survival. If the orchards are unable to provide future seed because of tussock moth mortality, or if seed production is delayed due to growth losses from defoliation, the benefits of parent tree selection and breeding could be lost or delayed.

PROPOSED ACTION

ALL FORESTS

This alternative would protect all susceptible seed orchards. When considered in combination with past, present, and reasonably foreseeable future actions, there would be no cumulative effect from implementing this alternative.

EXPANDED PROTECTION ALTERNATIVE

ALL FORESTS

This alternative would protect all susceptible seed orchards. When considered in combination with past, present, and reasonably foreseeable future actions, thee would be no cumulative effect from implementing this alternative.

TM-BIOCONTROL ONLY ALTERNATIVE

ALL FORESTS

This alternative would protect all susceptible seed orchards. When considered in combination with past, present, and reasonably foreseeable future actions, thee would be no cumulative effect from implementing this alternative.

WATER QUALITY: DEFOLIATION EFFECTS

The primary affects to water quality from a tussock moth outbreak would be from changes in stream temperature, sedimentation, or nitrogen levels. Temperature is the most common water quality concern for all water bodies in the Pacific Northwest. Defoliation of stands adjacent to streams can result in more sunlight reaching the water. Potential changes in temperature depend on the degree of defoliation, the orientation of the stream, the volume of water in the stream, adjacent topography, and channel characteristics. The potential to raise stream temperature is also related to the length of stream that passes through an area of greater than 60% host type. There is a substantial probability that localized stream temperature would increase if a 60-100% host type stand were completely defoliated. Lesser amounts of defoliation can also alter stream temperature but it is unlikely partial defoliation of 0-60% host type stands would increase temperature to a level that is statistically significant.

Sedimentation is a function of many variables: soil characteristics, geology, topography, vegetative cover, and whether the area is susceptible to peak flow events. Defoliation effects on rain-on-snow or snowmelt processes are small. This is because tree boles and limbs remain after defoliation. Canopy and airflow dynamic interactions that affect snow accumulation or melt rates are not expected to change significantly in defoliated areas. Although defoliation could change the vegetative cover, which could have some affect on sedimentation, the expectation is that it would not be significant. Stand defoliation would probably not increase surface erosion or sedimentation even if it occurred on large tracts of land in areas of more than 60% host type.

Changes in nitrogen levels in water bodies could result from the direct introduction of insect frass or through decay and assimilation of organic materials. Streams that currently exceed water quality standards for nitrogen are linked to fertilizer use and septic systems. It is not likely that defoliation or needle decay would result in measurable changes in nitrogen levels of any form of nitrogen.

Other water quality variables are not considered to be substantially or significantly at risk of change as the result of defoliation of host type. While changes in temperature could result in some change in dissolved oxygen levels and perhaps, the level or diversity of aquatic organisms, such changes are expected to be immeasurable. Small changes in pH could result from changes in temperature or aquatic organisms; this change is expected to be immeasurable. Changes in stream flow or aquatic habitat from defoliation or treatment of stands are expected to be immeasurable. Any changes in stream-flow from defoliation would not be detectable at the watershed or sub-watershed scales. Although changes in tree vigor in response to insects and defoliation could have an effect on transpiration and, hence, on water yield, these changes would be immeasurable. Channel morphology, habitat complexity, and localized stream characteristics could be altered by an increase in downed woody debris from defoliation. It would be impractical to predict the impacts as to size, quantity, and configuration of this debris because the exact location of defoliation is not predictable.

The secondary effect of most concern is the increased risk of fire and severity of fire. If severe or moderate defoliation occurs, fuel availability, risk of ignition, and risk of larger fires increases. If fire does occur after defoliation, there would be an increase in sedimentation. The exposure of bare soil to rain-on-snow events can change dramatically.

As stated above, defoliation along streams is just one factor that could contribute to stream temperature increases. Protection of the streamside areas (for out to 300 feet on each side of the stream) is therefore a factor that could result from a tussock moth outbreak and is measurable. Significant environmental effects would be in areas with 60-100% host type. The following table displays the unprotected acres and miles of streams for each alternative.

No Action Alternative

About 4,750 miles of streams would be unprotected in 60%-100% host type. The number of miles in host type are in indication of the risk of defoliation, and hence the risk of an increase in stream temperature. There is no significant effect expected on nitrogen levels or sedimentation from defoliation only. The secondary effect is the increased risk of fire and severity of fire. If severe or moderate defoliation occurs, fuel availability, risk of ignition, and risk of larger fires increases. If fire does occur after defoliation, there would be an increase in sedimentation.

Proposed Action

About 942 miles of streams with 60%-100% host type would be protected. That leaves about 5,700 miles unprotected. The potential for defoliation that could cause increased temperature in streams is less than the No Action alternative but the opportunity is still significant. The risk of fire described in the No Action alternative is less, but is still therein unprotected areas. However, the Areas of Concern as described in the Proposed Action would be removed from an increased risk.

Expanded Protection Alternative

About 4,990 miles of streams with 60%-100% host type would be protected. Around 710 miles would be left unprotected. This significantly reduces overall exposure for defoliation caused temperature increases and the risk of increased sedimentation from possible increased risk of fire.

TM-Bio-Control Only Alternative

The effects are the same as the Proposed Action.

Table IV-5: Streams with >60% Host Type

Forest	No Action Alt.		Proposed Action & TM-BioControl Alt.		Expanded Protection Alt.	
	Unprot. Acres	Unprot. Miles	Unprot. Acres	Unprot. Miles	Unprot. Acres	Unprot. Miles
Colville	582,240	1099	575,420	1,086	21,800	36
Okanogan	373,620	742	290,900	560	26,570	91
Wenatchee	77,980	159	37,520	81	5,840	13
Umatilla	606,300	1437	515,210	1,083	165,530	343
W-W*	498,270	1277	429,580	1,105	60,530	135
Malheur	335,450	815	87,950	739	29,000	64
Ochoco	41,780	86	11,980	20	5,340	8
Winema	69,020	80	68,580	80	20,470	17
Fremont	1,370	2	980	0	950	0
Total Unprotected Acres	2,586,030		2,018,120		336,030	
Total Unprotected Stream Miles		5,697		4,754		707

WATER QUALITY: EFFECTS OF TUSSOCK MOTH & INSECTICIDE

Actual effects of increased Douglas-fir tussock moth larvae in the water are not known. The high densities of caterpillars during an outbreak increase significantly as larvae search for food. Some fall into water. In addition, the larvae produce a large amount of fecal matter. During heavy defoliation, water quality could be affected by direct contamination with frass. However, no adverse effects on human health have ever been reported from streams in infested areas. Eventually, most larvae die from the natural virus as the outbreak runs its course. Dead larvae fall into streams, introducing the virus to the water. No adverse human health effects are expected from either larval frass or the virus.

EFFECTS OF B.T.K. ON WATER QUALITY

Some of the proposed protection areas are along streams and bodies of water. These sites were usually selected to protect existing habitat and vegetation from defoliation. Insecticide application along streams could result in some spray deposited directly into the water. Insects feeding in the forest canopy directly over these water bodies could also introduce larvae, fecal matter, and virus directly into the water. In two studies, viable B.t.k. spores were found in rivers, 13 days and 4 weeks, respectively, following spraying (cited in USDA, 1995). For the DFTM project, B.t.k. would be applied at a rate of 64 – 96 oz. per acre. Any amount reaching water would be diluted and reduced significantly. The concentrations that would reach the water through aerial application would not affect water quality

EFFECTS OF TM-BIOCONTROL ON WATER QUALITY

Water quality would probably not be affected by treatment with TM-BioControl either. The virus is persistent and able to survive for long periods under a variety of conditions. Virus lasts longer dry than wet, but in general, water does not affect survival, especially for short-term exposures of less than 30 days (Ignoffo, 1992, cited in USDA, 1995). Although the virus could survive in water, it is species specific and would have no effect on water quality. As with B.t.k. the small amounts that might reach water would be diluted quickly in running streams. In addition, the TM-BioControl risk assessment determined that application of TM-BioControl would introduce only 3% more virus to the environment than would occur during a normal outbreak (SERA, 1999).

FISH & WILDLIFE: THREATENED AND ENDANGERED SPECIES INCLUDED IN PROJECT OBJECTIVES

As stated in the Purpose and Need (Chapter I), protection of the habitats of anadromous fish, bull trout, spotted owls, and bald eagles were included in the Project Objectives. The potential effects of each alternative on these species are discussed in detail below. Effects on other threatened and endangered species are discussed in the next section (page IV-27).

Overview: Effects of defoliation on Riparian Areas

Potential Temperature Changes as Related to a Tussock Moth Outbreak: Streamside vegetation is an important component of anadromous fish and bull trout habitat. It provides essential shade to streams, thereby regulating stream temperatures. Defoliation of stands adjacent to streams can result in additional sunlight reaching the water. The degree to which potential defoliation of riparian host trees may increase stream temperatures depends on many physical characteristics. This includes rate of flow, aspect, topography as a source of shade, channel width, sinuosity and other channel features, and the level of groundwater upwelling (Beschta, et. al., 1987, Beschta et. al., 1997, Brown 1972, Brown 1985, and Beschta 1987). A reduction in shade in some areas may result in increased stream temperatures, potentially causing a reduction in habitat suitability for anadromous fish and bull trout, particularly in spawning and rearing sites. This reduction in habitat suitability would most likely reduce fish usage of these areas during the periods of elevated temperatures. In other areas, a reduction in shade may cause little to no increase on the temperature of the adjacent stream reach due to topographical shading or other physical stream and landscape attributes.

Sites where tussock moth defoliation could reduce the habitat suitability for bull trout and anadromous fish are proposed for protection in this project. However, defoliation of some stands adjacent to anadromous fish and bull trout streams is not expected to cause a measurable increase in stream temperature for the following reasons:

1. Many fish-occupied streams are wide and shallow, and not dependent on riparian shading for temperature regulation.
2. The outbreak would probably be patchy and of varying intensity. On a landscape level, defoliation at low-risk sites is expected to be <40% with approximately 1% mortality; defoliation at moderate-risk sites would probably be 40-60% with approximately 5% mortality; defoliation at high-risk sites could be >60% with approximately 48% mortality. Even with some degree of defoliation, the boles of defoliated trees, non-host tree species, and understory riparian vegetation would still provide stream shade.
3. Risk of defoliation is low in some riparian stands because of their location. Douglas-fir tussock moth outbreaks are more likely in moisture-deficient stands with poor growing conditions for Douglas-fir and true firs. In eastern Oregon, outbreaks are more likely to occur on ridges.
4. Topographic features often provide more shade to streams than riparian vegetation.
5. Many threatened or endangered fish species spawn in the spring and fall when waters are naturally cold.

6. Due to the patchiness of the outbreak, moderate/high defoliation of host type would probably occur in small, discontinuous blocks along streams. At many sites, this could benefit fish habitat by providing long-term recruitment of dead woody debris to the streams.

7. Many streams stay cool by receiving an abundant amount of subsurface flow.

Sedimentation is a function of many variables including soil characteristics, geology, topography, vegetative cover, soil disturbance, and peak flow events (Bunto, et. al., 1998). Defoliation could reduce transpiration, which could potentially cause longer periods of soil saturation (especially in the fall and spring) and could potentially increase the frequency of average annual peak flows. This could have some influence on sediment transport. However, the expectation is that this would not be significant. Defoliation of stands would not result in soil disturbance and subsequent appreciable increases in surface erosion or sedimentation over current levels even if defoliation were to occur on large tracts in areas of greater than 60% host type (B. McCammon, pers. comm., 2000). Thus, defoliation is not predicted to have an impact on stream substrate for bull trout.

Defoliation is predicted to occur in a mosaic pattern of variable intensity. Defoliation effects on rain-on-snow or snowmelt processes are small. This is partly because many of the defoliated trees would not suffer mortality and would grow back their needles in 3-5 years (I. Ragenovich, pers. comm. 2000). If defoliation did result in mortality, tree boles and limbs would remain. Canopy and airflow dynamics that affect snow accumulation and melt are not likely to be different under either the Proposed Action or No Action Alternative. Similarly, potential changes in stream flow, related to transpiration decreases defoliation, would probably not different between alternatives. In any watershed, stream flow would probably only be affected by defoliation only if the defoliation was equivalent to a clear-cut over more than 10-15% of the watershed (Stednick, 1995, Jones and Grant 1996). Only a small percentage of each watershed is proposed for protection to limit defoliation. Because the amount of proposed spraying in any given watershed is much less than fifteen percent of that watershed, the differences in stream flow between the Proposed Action and no action alternative is not likely detectable.

There is a relatively slow recruitment of dead woody debris for a long period, after defoliation. This slow recruitment of dead wood probably provides a longer-term and more stable supply of dying and dead wood compared to more rapid turnover of snags and logs after a stand-replacement wildfire (Youngblood and Wickman, In Press). Channel morphology, habitat complexity, and localized stream characteristics may be altered by an increase in down woody debris from defoliation of riparian vegetation. It would be impractical to quantitatively predict the impacts as to size, quantity, and configuration of this debris because the exact location of defoliation is not predictable. However, it can be predicted that most of the potential increase in large woody debris would come from areas of high risk host type that become defoliated. This would usually occur in small to moderate sized patches scattered along the stream. An abundant amount of additional input of large woody debris would be suspected to occur in areas of high risk along streams, and very little to no additional input would be suspected in areas of moderate to low risk.

NO ACTION ALTERNATIVE

ALL FORESTS

Bald Eagle Habitat: All nine National Forests have known or potential bald eagle habitat in their boundaries. If an outbreak of the tussock moth occurred in the project area, defoliation and subsequent mortality could occur in bald eagle habitat.

Known or potential bald eagle communal roosting and some nesting sites could be degraded if an outbreak of the tussock moth occurred in the stands. Eagles usually require multi-storied structured stands with an overstory component. Loss of this canopy closure through defoliation and subsequent mortality could reduce the habitat suitability for the eagles. The Umatilla National Forest has an active bald eagle nest that could be negatively impacted by a tussock moth outbreak. However, some of the known bald eagle nest sites that occur in host type, especially on the Ochoco and Winema National Forests, would probably not be negatively affected by an outbreak. Defoliation in stands used for breeding could benefit habitat. These stands still contain large-diameter pines, but are mostly densely stocked Douglas-fir or white fir. Control of stocking is perhaps the best method to prolong the life and health of currently suitable nesting, roosting, and perch trees. Removal of true firs and other understory species in pine forests can reduce stress and susceptibility of pines to bark beetle infestations (USFWS, 1986).

Some bald eagle habitat could be negatively impacted by a reduction in canopy closure and loss of structure in some stands. However, other bald eagle habitat could be beneficially affected by defoliation and subsequent mortality naturally thinning out the stands and thus prolonging the life and health of currently suitable habitat. *In conclusion, there could be both negative and positive effects on bald eagle habitat under the No Action Alternative.*

COLVILLE NATIONAL FOREST

Bull Trout Habitat: Of the 60 miles of known, suspected, or potential bull trout occupied streams in host type, approximately 43 miles occur mainly in non-host species with low risk of defoliation. Defoliation in these areas is not expected to affect bull trout habitat. The 17 miles of bull trout streams adjacent to moderate/high risk areas are scattered in small patches. Defoliation at these sites is not predicted to be extensive enough to cause a substantial change in the aquatic environment. *This alternative would have no effect on bull trout habitat.*

OKANOGAN NATIONAL FOREST

Anadromous Fish Habitat: None of the streams in host type that are occupied by anadromous fish would be protected under this alternative. However, defoliation is not predicted to degrade anadromous fish habitat in these streams. *The No Action Alternative would have no effect on anadromous fish habitat.*

Bull Trout Habitat: None of the streams occupied by bull trout in host type would be protected. There is an isolated spawning and rearing area for bull trout in a substantial amount of high hazard risk host type on 4 miles of Beaver Creek (Methow River tributary). If a DFTM outbreak occurred along this reach, defoliation could be heavy. If defoliation was severe, the loss of shade could lead to an increase in stream temperature, which could degrade the spawning and rearing habitat. All other stream reaches occupied by bull trout in host type would probably not be negatively impacted by a tussock moth outbreak. T*he overall effect of this alternative on bull trout habitat would be negative.*

Spotted Owl Habitat: None of the spotted owl critical habitat units, activity centers, or Late Successional Reserves would be protected from a tussock moth outbreak. Habitat losses would be more likely to occur in high-risk host type. In the critical habitat units, there could be an estimated loss of 1700 acres of nesting, roosting, foraging, and dispersal habitat. For outbreaks in the five 0.7-mile buffer activity centers that have the presence of host type, there could be an effect on current or recently occupied spotted owl habitat. An estimated 552 acres of spotted owl habitat could be lost. If tussock moth defoliated Late Successional Reserves, habitat set aside to provide current or future late-successional habitat for the spotted owl could be affected. An estimated 6,200 acres in LSRs could be affected. There would be no disturbance to spotted owls with implementation of this alternative. *There would be a negative effect of the No Action Alternative on owl habitat.*

WENATCHEE NATIONAL FOREST

Anadromous Fish Habitat: None of the streams in host type that are occupied by anadromous fish would be protected from a tussock moth outbreak. There are approximately 18 miles of spawning and rearing reaches in the Wenatchee River drainage where severe defoliation of the adjacent stands by the tussock moth has the potential to degrade the habitat. These include the following: Mission Creek and its tributary Sand Creek, as well as the upper reaches of Peshastin and its tributary, Transen Creek.

Defoliation could cause a substantial reduction in the amount of shade provided to these reaches, thereby causing an increase in stream temperature in these reaches. All other stream reaches in host type occupied or suspected to be occupied by anadromous fish would probably not be affected by a tussock moth outbreak. *Overall, the No Action Alternative would have a negative effect on anadromous fish.*

Bull Trout Habitat: None of the streams known or suspected to provide habitat for bull trout in host type would be protected. This includes known bull trout spawning and rearing sites on the Mad and South Fork Tieton Rivers. There is approximately 5 miles of moderate-risk host type scattered throughout the riparian area. If a severe outbreak occurred in these sites, defoliation and subsequent mortality could result in a loss of shade, potentially increasing stream temperatures. This could degrade bull trout spawning and rearing habitat. These two bull trout spawning and rearing reaches are the only ones known that occur in environmental conditions (i.e. narrow stream reach with 60-100% host type of moderate risk) in which defoliation and subsequent mortality would have this affect. All other streams occupied by bull trout in host type would probably be unaffected. *Overall, the No Action Alternative would have a negative effect on bull trout habitat.*

Spotted Owl Habitat: None of the spotted owl critical habitat units, activity centers, or Late Successional Reserves would be protected from a tussock moth outbreak. Habitat losses due to defoliation and subsequent mortality would more likely occur in high-risk host type. If an outbreak occurred in the critical habitat units, there could be an estimated loss of 3500 acres of nesting, roosting, foraging habitat, and 1500 acres of dispersal habitat. If outbreaks occurred in the 118 0.7-mile buffer activity centers that have the presence of host type, there could be an effect on current or recently occupied spotted owl habitat. It is estimated that 3,200 acres of spotted owl habitat could be lost. None of the Late-Successional Reserve habitat would be protected. During an outbreak, there could be a loss of habitat in areas formerly set aside to provide current or future late-successional habitat for spotted owls. An estimate of 8,200 acres in LSRs and MLSRs could be lost. There would be no disturbance to spotted owls. *This alternative would have a negative effect on owl habitat.*

UMATILLA NATIONAL FOREST

Anadromous Fish Habitat: None of the streams in host type occupied by anadromous fish would be protected. Anadromous fish populations in the North Fork Asotin Creek, North Fork Umatilla River, and the North Fork Meacham Creek could be negatively affected by a tussock moth outbreak. The North Fork Touchet River, Tucannon River, Lookingglass Creek, Mill Creek (Walla Walla and Pomeroy Ranger Districts), Desolation Creek, Camas Creek, and Pearson Creek also provide anadromous fish habitat that could be negatively affected by tussock moth. Based on the magnitude and extent of moderate/high risk host type in these riparian areas, defoliation and subsequent mortality could result in a loss of shade provided to the streams, thus potentially elevating stream temperatures. This could degrade anadromous fish habitat. In total, approximately 179 miles could be negatively affected.

However, the South Fork Walla Walla River and the Wenaha River sub-watersheds would probably benefit

from a DFTM outbreak. The Wenaha River watershed contains a large population of anadromous fish. Prevention of wildfire and insect infestations may be contributing to a decline in in-stream large woody debris in the drainage. Tree mortality in riparian areas could create a new supply of large woody debris. Since tree mortality is predicted to be patchy at these sites, anadromous fish would still have sufficient high quality/low temperature habitat while spots for future fish production might be created.

If there was an outbreak on the Umatilla, 13,000 acres of high-risk host type in the Snake River chinook salmon critical habitat unit ("CHU") could experience heavy defoliation and subsequent mortality. Depending on the extent and magnitude of the outbreak, there is the potential that a reduction of shade would be great enough to cause an increase in stream temperature. The Snake River critical habitat unit could be degraded.

The overall effect of the No Action Alternative on anadromous fish habitat would be negative.

Bull Trout Habitat: None of the streams occupied by bull trout in host type would be protected from a tussock moth outbreak. The bull trout subpopulations in the North Fork Asotin Creek, North Fork Umatilla River, and the North Fork Meacham Creek have the least likelihood of survival on the forest. The Asotin Creek drainage has a single, small, isolated, non-migratory population of bull trout at high risk of extinction. There are major spawning areas for bull trout in the North Fork Umatilla River drainage, of which most is in the North Fork Umatilla Wilderness. These areas contain abundant host type at moderate/high risk. If a severe outbreak occurred in these sites, defoliation and subsequent mortality could result in a loss of shade and increase in stream temperatures. This could degrade bull trout spawning and rearing habitat at these sites. Most of the anadromous fish streams mentioned above also provide habitat for bull trout. If an outbreak occurred in these sites, defoliation could result in an increase in stream temperatures, potentially degrading bull trout habitat. Approximately 98 miles of bull trout streams could be negatively affected by an outbreak. An outbreak in the South Fork Walla Walla River and the Wenaha River watersheds could benefit bull trout habitat through the creation of additional large woody debris. *There would be an overall negative effect on bull trout habitat from the No Action Alternative.*

WALLOWA-WHITMAN NATIONAL FOREST

Anadromous Fish Habitat: No anadromous fish streams in host type would be protected under this No Action Alternative. Some of these could be negatively impacted by an outbreak of tussock moth. These areas include Catherine Creek and tributaries, Indian Creek and tributaries, Lostine River, Big Sheep Creek and tributaries, Imnaha River and Grouse Creek, Joseph Creek and tributaries, and Granite Creek and tributaries. These streams are in areas of abundant moderate/high-risk host type where a tussock moth outbreak could result in substantial defoliation and subsequent mortality. Loss of canopy closure could elevate stream temperatures and could degrade fish habitat. In total, approximately 92 miles of anadromous fish riparian zones could be negatively affected. All other streams in host type that are occupied by anadromous fish would probably not be affected.

If an outbreak occurred on the Wallowa-Whitman, 50,000 acres of high risk host type in the Snake River chinook and sockeye salmon critical habitat units could experience heavy defoliation and subsequent mortality. Depending on the extent and magnitude of the outbreak, there is the potential that a reduction of shade would be great enough which would cause an increase in stream temperature. The Snake River critical habitat units could be degraded.

The overall effect of this alternative on anadromous fish habitat would be negative.

Bull Trout Habitat: No bull trout streams in host type would be protected. As a result, some streams could be negatively impacted by an outbreak of tussock moth. This includes parts of Lightning Creek, the upper reaches of Lostine River, Minam River, Little Minam River, and Imnaha River. These areas all have abundant moderate/high risk host type where substantial defoliation could elevate stream temperature and degrade bull trout habitat. In total, approximately 85 miles of bull trout streams could be negatively affected. *The effect of the No Action Alternative on bull trout habitat would be negative.*

MALHEUR NATIONAL FOREST

Anadromous Fish Habitat: Since none of the anadromous fish streams in host type would be protected under the No Action Alternative, several reaches could be negatively impacted if a tussock moth outbreak occurred. All are located in the main stem and middle fork drainages of the John Day River, specifically the upper reaches of the Middle Fork John Day River, the headwaters of Vinegar and Clear Creek, and the headwaters of Beech, Fields, Canyon, Deer, and Reynolds Creeks. They are in areas with abundant moderate/high risk in large, contiguous patches. Substantial defoliation and subsequent mortality could increase stream temperatures. In total, about 31 miles could be negatively impacted by a tussock moth outbreak. *The effect of this alternative on anadromous fish habitat would be negative.*

Bull Trout Habitat: No occupied bull trout streams would be protected, and as a result, some could be negatively impacted. This includes Vinegar Creek on the Long Creek Ranger District, the Reynolds Watershed, the headwaters of the Middle Fork of John Day River, and the Phink and Elk Watersheds, particularly the North Fork Malheur River and tributaries of the Middle Fork Malheur River in the McCoy and Wickiup watersheds. Defoliation of the abundant moderate/high risk host type in large, contiguous patches could increase stream temperatures and could degrade the bull trout habitat. In total, approximately 39 miles of bull trout streams could be negatively affected

during a tussock moth outbreak. *There would be a negative effect on bull trout habitat from implementation of the No Action Alternative.*

OCHOCO NATIONAL FOREST

Anadromous Fish Habitat: None of the streams in host type that are occupied by anadromous fish would be protected from a tussock moth outbreak. The entire Ochoco Forest anadromous population is located in a narrow strip near the northern boundary of the Forest. This is also where most of the host type is concentrated. A severe outbreak could reduce shade in portions of this area, potentially elevating stream temperatures and degrading the fish habitat. In total, approximately 102 miles could be negatively impacted. *The effect of this alternative on anadromous fish habitat would be negative.*

WINEMA NATIONAL FOREST

Bull Trout Habitat: Only one known occupied bull trout stream, Threemile Creek, occurs on the Forest, of which 2 miles is in host type. This area would not be protected in this alternative. There is the potential that this portion could be defoliated by the Douglas-fir tussock moth. However, current stream temperatures are below 50°, well in the standard considered acceptable for bull trout (D. Forbes, pers. comm., 1999), and the host is mostly low/moderate-risk or non-host species. If defoliation and mortality occurred, there would still be live, foliated trees to provide stream shade. Tree mortality could have a beneficial effect by increasing the amount of large woody debris that is currently lacking in the stream (B. Rietman, pers. comm., 1999). *The overall effect of the No Action alternative on bull trout habitat would be positive.*

Spotted Owl Habitat: None of the spotted owl critical habitat units, activity centers, or Late Successional Reserves would be protected from a tussock moth outbreak. Habitat losses would be more likely to occur in high-risk host type. If an outbreak occurred in these critical habitat units, there could be an estimated loss of 5,550 acres of nesting, roosting, foraging habitat, and 1,320 acres of dispersal habitat. If outbreaks occurred in the 56 activity centers that have the presence of host type, there could be an effect on current or recently occupied spotted owl habitat. It is estimated that 900 acres of spotted owl habitat could be lost. None of the Late-Successional Reserve habitat would be protected. During an outbreak, there could be a loss of habitat in areas formerly set aside to provide current or future late-successional habitat for spotted owls. An estimate of 8,200 acres in LSRs and MLSRs could be lost. There would be no disturbance to spotted owls.

The effects of degrading or reducing spotted owl and late-successional habitat due to an outbreak of the tussock moth would not be as severe on the Winema as compared to the Okanogan and Wenatchee. Spotted owl nesting, roosting, foraging habitats, and late-successional stands are more contiguous and less fragmented on the Winema National Forest than the other two forests. *The overall effect of the No Action Alternative on owl habitat would be negative.*

FREMONT NATIONAL FOREST

Bull Trout Habitat: The No Action Alternative would not protect the headwaters of Demming Creek, the only known bull trout reach in host type on the Forest. Approximately 3 miles of the upper reaches are at mostly a moderate risk for defoliation and mortality. Most of this reach is heavily shaded by true firs and could suffer substantial defoliation if a severe tussock moth outbreak occurred. Bull trout habitat could be degraded in this area. Due to population isolation and the high risk of extirpation for the majority of bull trout subpopulations in the Klamath Basin, degradation of the Demming Creek habitat could have negative consequences to this bull trout subpopulation. *This alternative would have a negative effect on bull trout habitat.*

Effects Determination Summary

Anadromous Fish: **No Effect** – Okanogan National Forest. **May Affect, Likely to Adversely Affect** – Wenatchee, Wallowa-Whitman, Umatilla, Malheur, and Ochoco National Forests.

Bull Trout: **No Effect** – Colville and Winema National Forests. **May Affect, Likely to Adversely Affect** – Okanogan, Wenatchee, Wallowa-Whitman, Umatilla, Malheur, and Fremont National Forests.

Spotted Owl: **May Affect, Likely To Adversely Affect** – Okanogan, Wenatchee, Winema National Forests. Defoliation and subsequent mortality from the tussock moth could result in a degradation or removal of spotted owl nesting, roosting, forage, or dispersal habitat in critical habitat units.

Bald Eagle: **May Affect, Not Likely To Adversely Affect** – Colville, Okanogan, Wenatchee, Wallowa-Whitman, Ochoco, Malheur, Winema, and Fremont National Forests. Some bald eagle habitat would be negatively affected by a reduction in canopy closure and loss of structure in some stands. Other bald eagle habitat could be beneficially affected by defoliation and subsequent mortality naturally. **May Affect, Likely to Adversely Affect** – Umatilla. There could be a loss of bald eagle nesting habitat.

PROPOSED ACTION

ALL FORESTS

Bald Eagle Habitat: Bald eagle nests are usually located in multi-storied stands with old-growth characteristics (USFWS, 1986). Many bald eagle nests in host type occur in stands with this type of structure. Green trees weakened by partial defoliation could die from bark beetles or other infestations. Total tree mortality could reduce old growth quality. The Pacific Bald Eagle Recovery Plan states that timber stands used by eagles should be managed to prevent insect infestations where appropriate (USFWS, 1986). Bark beetles are a threat to eagle habitat in certain areas in the Pacific recovery area.

There is one bald eagle nest in host type, on the Umatilla National Forest, that could become unsuitable for nesting by bald eagles if the nest stand was defoliated and was proposed for protection in this alternative. Although there are other bald eagle nest sites in the project area that could be negatively affected by a DFTM outbreak, they were not proposed for protection because the potential for disturbance to the fledglings with application of the pesticides would be more detrimental than the defoliation and subsequent mortality itself.

In some bald eagle habitat, specifically on the Ochoco and Winema National Forests, defoliation in stands used for breeding could actually benefit the habitat. These stands still contain large-diameter pines but with dense Douglas-fir or white fir. Control of stocking could be the best method to prolong the life and health of these currently suitable nesting, roosting, and perch trees. Removal of true firs and other understory species could reduce stress and susceptibility of the pines to bark beetle infestations (USFWS, 1986).

A negative effect of the proposed treatment on bald eagle habitat is as follows. Proposed treatment areas could perpetuate "over-stocked" stands that could reduce the vigor of potential nest trees.

There would be an avoidance of bald eagle nests during project implementation except for the bald eagle nest on the Umatilla (See Umatilla bald eagle effects below). The treatment period for this project is between mid-June and mid-July. Since this coincides with the nesting period (Jan. – Aug.) of the bald eagle, all project aircraft would stay outside of the following "no disturbance buffers" for the following forests:

- Colville, Wenatchee, Wallowa-Whitman: 1 mile horizontal; 1000' vertical
- Ochoco, Winema[14]: ½ mile horizontal; 1000' vertical

Defoliation has the potential to degrade Some bald eagle habitat would be negatively impacted by a reduction in canopy closure and loss of structure in some stands. However, other bald eagle habitat could be beneficially affected by defoliation and subsequent mortality naturally thinning out the stands and thus prolonging the life and health of currently suitable habitat. *In conclusion, there could be both negative and positive effects on bald eagle habitat under the Proposed Action.*

COLVILLE NATIONAL FOREST

Bull Trout Habitat: There are no bull trout reaches proposed for protection. Of the 60 miles of known, suspected, or potential bull trout occupied streams in host type, approximately 43 miles occur mainly in non-host species with low risk of defoliation. Defoliation in these areas is not expected to affect bull trout habitat. The 17 miles of bull trout streams adjacent to moderate/high risk areas are scattered in small patches. Defoliation at these sites is not predicted to be extensive enough to cause a substantial change in the aquatic environment. *The Proposed Action would have no effect on bull trout habitat.*

OKANOGAN NATIONAL FOREST

Anadromous Fish Habitat: No specific anadromous fish reaches were proposed for protection because there are no streams where defoliation is predicted to degrade habitat. However, approximately 55 miles of streams occupied by anadromous fish would be protected in this alternative because Areas of Concern for other resources overlap anadromous fish streams. The potential protection areas include the upper reaches of the Chewuch River, Twisp River, Gold Creek, Wolf Creek, Goat Creek, Lost River, the upper reaches of the Methow River, and Buttermilk Creek. Protection in these areas would have no effect on anadromous fish habitat. In unprotected areas adjacent to anadromous fish habitat, the effects would be the same as those described in the No Action Alternative. *Overall, there would be no effect of the Proposed Action on anadromous fish habitat.*

Bull Trout Habitat: The only isolated spawning and rearing habitat for bull trout on the Okanogan Forest is located in a 4-mile segment of Beaver Creek, a tributary of the Methow River. This reach falls in a substantial amount of high-risk host type. If severe defoliation occurred, an increase in stream temperature could degrade this important habitat. This reach is being proposed for protection in the Proposed Action. In addition, approximately 52 miles are proposed for protection because Areas of Concern for other resources overlap these anadromous fish streams. The potential protection areas include parts of the Chewuch River, Twisp River, Buttermilk Creek, Methow River, Gold Creek, Wolf Creek, Goat Creek, and Early Winters Creek. Protection of these areas would have no effect on bull trout habitat. In unprotected areas, effects would be the same as those described in the No Action Alternative. *The overall effect of the Proposed Action would be positive.*

Spotted Owl Habitat: Under the Proposed Action, approximately 18,000 acres in 2 of the 3 spotted owl critical habitat units would be protected. In addition, all spotted owl activity centers in host type, outside Wilderness, would be protected to prevent degradation of owl habitat: 0.7 mile radius; 5 centers; 3000 acres, some of which overlap critical habitat unit acreage. Parts of the Twisp River and Upper Methow Late Successional Reserves (16,600 acres) would be protected to prevent loss of late successional stands due to defoliation, mortality, and increased risk of wildfire. Several other LSRs in host type would be protected for other resource concerns. In total, about 49,000 acres of LSR would be protected (this acreage may overlap acreage in the critical habitat units and activity centers described above). Treatment would meet all standards and guidelines in the *1994 Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents In the Range of*

[14] The buffer nest just south of the Mare's Egg Spring protection area would be slightly less than a ½ mile.

the Northern Spotted Owl and the *1998 Okanogan Assessment of the Northeastern Cascades Late Successional Reserves*. The project proposal is consistent with these documents as they relate to treating Late Successional Reserves for control of a tussock moth outbreak. Because aircraft could operate in the ¼ mile buffer of many activity centers and in suitable, un-surveyed habitat between mid-June and mid-July, owls could be disturbed. This disturbance could include noise and prop-wash/down-draft caused by low-flying aircraft. Flight paths could cross directly overhead of an activity center, with additional flights alongside. The frequency and location of these flights in relation to the activity centers would be determined by the distribution and location of the tussock moth outbreak. *The overall effect of the Proposed Action on spotted owl habitat would be positive.*

WENATCHEE NATIONAL FOREST

Anadromous Fish Habitat: There are several spawning and rearing reaches in the Wenatchee River drainage, specifically in Mission Creek, Sand Creek, the upper reaches of Peshastin, and Transen Creek. Approximately 18 miles were identified as spawning and rearing habitat for anadromous fish where severe defoliation could degrade habitat (stream temperature increase). For this reason, these areas were selected for protection in the Proposed Action. Stand and vegetative structure would be maintained. An additional 23 miles of short, scattered stream segments would be protected for other resource concerns (the Naches, Nile, Rattlesnake, Little Rattlesnake, upper reaches of the Entiat, Mad; Wenatchee, and Chiwawa Rivers). Protection of these areas would have no effect on anadromous fish habitat. In unprotected areas adjacent to anadromous fish habitat, effects would be the same as those described in the No Action Alternative. *There would be a positive overall effect of the Proposed Action on anadromous fish habitat.*

Bull Trout Habitat: There are bull trout spawning and rearing sites on the Mad and South Fork Tieton Rivers. Approximately 5 miles have patches of moderate-risk host type scattered throughout their riparian areas. If a severe outbreak occurred in these sites, defoliation and subsequent mortality could result in elevated stream temperatures and degrade bull trout habitat. These two bull trout spawning and rearing reaches are the only ones known that occur in environmental conditions (i.e. narrow stream reach with 60-100% host type of moderate risk) in which defoliation and subsequent mortality would have this affect. About 5 miles are proposed for protection in the Proposed Action. Approximately 19 miles of known, suspected, or potential bull trout habitat would also be protected but for other resource concerns. This includes portions of the Entiat River, Chiwawa River, Wenatchee River, Peshastin Creek, Teanaway River, Naches River, Nile Creek, Tieton River, and Rattlesnake Creek. Protection of these areas would have no effect on bull trout habitat. In unprotected areas, effects would be the same as those described in the No Action Alternative. *The overall effect of the Proposed Action on bull trout habitat would be positive.*

Spotted Owl Habitat: Under the Proposed Action, 62,000 acres in 10 of the 17 spotted owl critical habitat units would be protected. In addition, all spotted owl activity centers in host type, outside Wilderness, would be protected to prevent degradation of owl habitat: 0.7 mile radius; 112 centers; 32,000 acres, some of which overlap critical habitat unit acreage. All host type in the following Late-Successional Reserves and Managed Late Successional Reserves would be protected to maintain spotted owl nesting, roosting, foraging and dispersal habitat: Upper Nile, Rattlesnake, Swauk, Deadhorse, Chiwawa, Shady Pass, Lucerne, DM-2, 3, 5, 6, 7, 10, 11 and 12. These LSRs and MLSRs have the greatest potential to be negatively impacted by defoliation and subsequent mortality. The Proposed Action would be protecting approximately 75,000 acres in these areas for the purposed of maintaining spotted owl nesting, roosting, foraging, and dispersal habitat. Several other LSRS and MLSRs would be protected to meet other resource objectives. In total, approximately 82,500 acres would be protected (this acreage may overlap acreage in the critical habitat units and activity centers described above).

Treatment would meet all standards and guidelines in the *1994 Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents In the Range of the Northern Spotted Owl* and the *1997 Wenatchee Assessment of the Northeastern Cascades Late Successional Reserves*. The project proposal is consistent with these documents as they relate to treating LSRs for control of a tussock moth outbreak.

Because aircraft could operate in the ¼ mile buffer of many activity centers between mid-June and mid-July, owls could be disturbed. This disturbance could include noise and prop-wash/down-draft caused by low-flying aircraft. Flight paths could cross directly overhead of an activity center, with additional flights alongside. However, most juvenile owls in host type on the Cle Elum Ranger District fledge by late May/early June and would be in the rearing stage during project operations. Thus, they would have some ability to move away from the disturbance (J. Richards, pers. comm., 2000). However, other districts on the Wenatchee have activity centers that are proposed for protection that have later fledgling dates. Therefore, there is an increased potential that project aircraft would disturb these young prior to them being mobile. The frequency and location of operational flights in relation to the activity centers would be determined by the distribution and location of the tussock moth outbreak. *The overall effect of the Proposed Action on spotted owl habitat would be positive.*

UMATILLA NATIONAL FOREST

Anadromous Fish Habitat: On the Umatilla, bull trout survival was used as an indicator of risk for other salmonids because they are less dependent on external watershed influences than other salmonids. Since most

bull trout habitat overlaps with anadromous fish habitat, protection of anadromous fish habitat was determined by the condition of the bull trout subpopulations (see bull trout effects below).

Protection could prevent defoliation in riparian areas adjacent to 179 miles of anadromous fish occupied streams. This could prevent any increase in stream temperature that could cause a degradation of habitat for anadromous fish. Stand and vegetative structure would be maintained.

Approximately 4,500 acres of riparian areas adjacent to CHU designated streams would be protected from an outbreak of the tussock moth. Stand and vegetative conditions would be maintained. The remaining 11,000 acres of high-risk host type would remain vulnerable to a tussock moth outbreak. However, these areas are not predicted to be degraded if an outbreak occurs. *The overall effect of the Proposed Action on anadromous fish habitat would be positive.*

Bull Trout Habitat: Three drainages are proposed for protection due to the condition of the bull trout populations. Populations in the North Fork Asotin Creek, North Fork Umatilla River, and the North Fork Meacham Creek have the least likelihood of survival on the Forest. The Asotin Creek drainage, with a single, small, isolated, non-migratory population of bull trout is at high risk of extinction and needs the most protection. The Proposed Action would protect upland and adjacent areas of this drainage. Protection of upland and riparian areas in the North Fork Umatilla River drainage is also desirable because major spawning areas have been documented (most of the protection area is in the North Fork Umatilla Wilderness). The North Fork Touchet River, Tucannon River, Lookingglass Creek, Mill Creek on the Walla Walla and Pomeroy Ranger Districts, and Desolation Creek, Camas Creek, and Pearson Creek on the southern half of the Forest would also be protected to maintain the existing habitat.

The magnitude and extent of moderate/high-risk type in the above riparian areas adjacent to the streams could result in degraded bull trout habitat if an outbreak occurred. If an outbreak occurred in these sites, defoliation and subsequent mortality could result in elevated stream temperatures. The protection of the surrounding uplands in the North Fork Asotin, North Fork Umatilla, and North Fork Meacham Creek drainages is to prevent an increase in the risk of a large stand replacement wildfire. Protection would maintain the existing stand and vegetative structure. Nearly 100 miles of bull trout streams could be protected.

Protection is not proposed in the South Fork Walla Walla River and Wenaha River watersheds, even though riparian habitat adjacent to bull trout streams are present in tussock moth host type. The Wenaha River watershed has a large population of bull trout - the migratory component is intact and migration corridors are present. Some of this watershed is in Wilderness. Prevention of wildfire and insect infestations may actually be contributing to declines in in-stream large woody debris in the drainage. Some mortality in riparian could benefit bull trout by creating a new supply of large woody debris. Since tree mortality is predicted to be patchy, bull trout would still have sufficient high quality/low temperature habitat while spots for future fish production were created. Affects on unprotected areas would be the same as those described in the No Action Alternative. *The overall effect of the Proposed Action on bull trout habitat would be positive.*

Bald Eagle Habitat: There is one active bald eagle nest on the Forest. Of the 125 acres of core nesting habitat (¼ mile around the nest), 50 are in host type. This area would be protected to maintain this nest site in the Proposed Action. Loss of tree cover from defoliation could negatively affect the habitat. If an outbreak occurred at this site, implementation of this alternative could involve treatment over both the nesting habitat and possibly the nest tree. This could create a disturbance to nesting eagles. However, past observations of the nest have shown that the juvenile eagles would probably have already fledged from the nest (C. Gobar, pers. comm., 1999). Project aircraft could startle birds from the nest, but that is predicted to be the extent of the impact. *The overall effect of the Proposed Action on bald eagle habitat would be positive.*

WALLOWA-WHITMAN NATIONAL FOREST

Anadromous Fish Habitat: Approximately 92 miles anadromous fish streams would be protected in the Proposed Action to prevent defoliation that could degrade habitat. This would include Catherine Creek and tributaries, Indian Creek and tributaries, Lostine River, Big Sheep Creek and tributaries, Imnaha River and Grouse Creek, Joseph Creek and tributaries, Granite Creek and tributaries, plus other small stream segments. The riparian areas adjacent to these streams have abundant moderate/high risk host type in which a tussock moth outbreak could result in substantial defoliation and subsequent mortality. This could result in a loss of canopy closure to the extent that might elevate stream temperature and potentially degrade anadromous fish habitat. In unprotected areas, effects would be the same as those described in the No Action Alternative.

Approximately 20,000 acres of riparian areas adjacent critical habitat unit streams would be protected from an outbreak of the tussock moth. Stand and vegetative conditions would be maintained. The remaining 44,000 acres of high-risk host type would remain vulnerable to a tussock moth outbreak. These areas are not predicted to be degraded if an outbreak occurs. *The overall effect of the Proposed Action on anadromous fish habitat would be positive.*

Bull Trout Habitat: The Proposed Action would protect approximately 85 miles of bull trout streams to prevent defoliation and possible degradation of bull trout habitat. This would include Lightning Creek, upper reaches of Lostine River, Minam River, Little Minam River, Imnaha River and other small stream segments. These streams are

bordered by abundant moderate/high risk host type in which a tussock moth outbreak could result in substantial defoliation and subsequent mortality. Bull trout streams in these areas could lose canopy closure to an extent that might elevate stream temperature and potentially degrade bull trout habitat. In unprotected areas, effects would be the same as those described in the No Action Alternative. *The overall effect of the Proposed Action on bull trout habitat would be positive*.

MALHEUR NATIONAL FOREST

Anadromous Fish Habitat: In this Proposed Action, several anadromous fish stream segments would be protected from tussock moth. These provide spawning and rearing habitat for anadromous fish where severe defoliation could degrade habitat. The reaches are all located in the main stem and middle fork drainages of the John Day River: upper reaches of the Middle Fork John Day River, headwaters of Vinegar and Clear Creek; and headwaters of Beech, Fields, Canyon, Deer, and Reynolds Creeks. All occur adjacent to large patches of moderate/high-risk host type. About 31 miles would be protected; the existing stand and vegetative structure would remain. In unprotected areas, effects would be the same as those described in the No Action Alternative. *The overall effect of the Proposed Action on anadromous fish habitat would be positive*.

Bull Trout Habitat: Approximately 39 miles of bull trout habitat would be protected in this Proposed Action: Vinegar Creek in the Long Creek Ranger District, streams in the Reynolds Watershed, the headwaters of the Middle Fork of John Day River, streams in the Phink and Elk Watersheds (especially the North Fork Malheur River), and tributaries of the Middle Fork Malheur River in the McCoy and Wickiup watersheds. The riparian areas along these streams have large contiguous patches of moderate/high-risk host type. Substantial defoliation and mortality could cause a loss of canopy closure sufficient to increase stream temperatures. Protection would maintain the existing stand and vegetative structure. In unprotected areas, effects would be the same as those described in the No Action Alternative. *The overall effect of the Proposed Action on bull trout habitat would be positive*.

OCHOCO NATIONAL FOREST

Anadromous Fish Habitat: Most of the anadromous fish streams in host type would be protected because the entire anadromous population on the Forest is where most of the DFTM host type is concentrated. A severe outbreak of tussock moth could degrade the habitat. In total, approximately 102 miles of anadromous fish streams would be protected from defoliation. Anadromous streams in the Black Canyon and Mill Creek Wildernesses would not be protected. Natural disturbance would be allowed to take place in these areas. In these unprotected areas, effects would be the same as those described in the No Action Alternative. *The overall effect of the Proposed Action on anadromous fish habitat would be positive*.

WINEMA NATIONAL FOREST

Bull Trout Habitat: Only one known occupied bull trout stream, Threemile Creek, occurs on the Forest, of which 2 miles is in host type. This area would not be protected in the Proposed Action. Although there is the potential for defoliation, current stream temperatures (< 50°) and the abundance of low/moderate-risk or non-host species would probably not affect bull trout habitat. Stand mortality could be beneficial by increasing the amount of large woody debris (B. Rietman, pers. comm., 1999). *The overall effect of the Proposed Action on bull trout habitat would be positive.*

Spotted Owl Habitat: Under the Proposed Action, neither of the two spotted owl critical habitat units would be protected. However, 2 spotted owl activity centers in host type, outside Wilderness, would be protected: 0.7 mile radius; 1600 acres. There would also be no protection of Late Successional Reserves. Treatment of the activity centers would meet all standards and guidelines in the *1994 Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents In the Range of the Northern Spotted.* Because aircraft could operate in the ¼ mile buffer of these two activity centers between mid-June and mid-July, owls could be disturbed. This disturbance could include noise and prop-wash/down-draft caused by low-flying aircraft. Flight paths could cross directly overhead of an activity center, with additional flights alongside. The frequency and location of these flights in relation to the activity centers would be determined by the distribution and location of the tussock moth outbreak. *The overall effect of the Proposed Action on spotted owl habitat would be positive.*

Bald Eagle Habitat: The Winema National Forest designated bald eagle habitat three ways: 1) eagle management area allocations with current or replacement nesting habitat, 2) nest sites with management plans, and 3) winter roost sites. The Proposed Action would incidentally protect just 400 acres of the 11,000 acres of designated habitat. These sites were previously dominated by ponderosa pine but have been invaded by white fir due to the exclusion of fire. Traditionally ponderosa pines have been the preferred roost trees on the Winema. The Proposed Action would prevent defoliation from occurring that potentially could have improved the bald eagle habitat in the area. *If treatment occurred in these 400 acres, there could be a small negative effect on bald eagle habitat under the Proposed Action.*

FREMONT NATIONAL FOREST

Bull Trout Habitat: Demming Creek has an isolated population of bull trout in host type. Approximately 2 miles are at moderate risk and 1 mile is at low risk for defoliation. The Demming Creek fish are one of only seven bull trout populations in the Klamath Basin; they are

considered the strongest and healthiest (C. Speas, pers. comm., 1999). The upper reaches of the creek are predominantly shaded by true firs. The lower reaches pass through non-Forest Service lands but probably also provide habitat for bull trout. Due to the predominance of host type in the upper reaches on National Forest land and isolation of the subpopulation, and the high risk of extirpation to most bull trout populations in the Klamath Basin, this stream would be protected in the Proposed Action. This could prevent an increase in stream temperature and subsequent degradation of habitat. Stand and vegetative structure would be maintained. *The effect of the Proposed Action on bull trout habitat would be positive.*

Effects Determination Summary

Anadromous Fish: **No Effect** – Okanogan National Forest. **May Affect, Not Likely to Adversely Affect (Beneficial Effect)** – Wenatchee, Wallowa-Whitman, Umatilla, Malheur, and Ochoco National Forests: The Proposed Action, including treatment with TM-BioControl may affect, but is not likely to adversely affect either the anadromous fisheries or its prey base. The protection of anadromous fish habitat from potential degradation of habitat could have a beneficial effect.

Bull Trout: **No Effect** – Ochoco and Winema National Forests. **May Affect, Not Likely to Adversely Affect (Beneficial Impact)** – Okanogan, Wenatchee, Wallowa-Whitman, Umatilla, Malheur, and Fremont National Forests: The Proposed Action, including treating with TM-BioControl may affect, but is not likely to adversely affect either bull trout or its prey base. The protection of bull trout habitat from potential degradation of habitat could have a beneficial effect.

Spotted Owl: **May Affect, Likely To Adversely Affect** – Okanogan, Wenatchee, Winema National Forests. The Proposed Action would not remove or degrade any spotted owl habitat defined as nesting, roosting, foraging or dispersal habitat in the estimated home-range, breeding radius, and habitat core surrounding activity centers. The project could potentially benefit habitat for the spotted owl by preventing outbreaks of the tussock moth, thus preventing losses of nesting, roosting, foraging, or dispersal habitat. The project could cause disturbance in a ¼ mile of several activity centers and in un-surveyed suitable habitat via aircraft.

Bald Eagle: **No Effect** – Colville, Okanogan, Wenatchee, Wallowa-Whitman, Malheur, and Fremont National Forests. Proposed protection would occur outside of a one-mile buffer for all bald eagle nests. **May Affect, Not Likely To Adversely Affect** – Ochoco and Winema National Forest. Proposed protection would occur outside of a ½ mile buffer for all bald eagle nests. **May Affect, Likely to Adversely Affect** – Umatilla National Forest. There is potential for disturbance by protection within 1/4 mile of a bald eagle nest. Preventing degradation of the stand structure surrounding the nest could have a beneficial effect.

EXPANDED PROTECTION ALTERNATIVE

COLVILLE NATIONAL FOREST

Bull Trout Habitat: An additional 51 miles would be protected over that of the Proposed Action. However, there would be no effect on bull trout habitat from the protection of these additional areas. *The overall effect of the Expanded Protection Alternative on bull trout habitat would be the same as the Proposed Action: no effect.*

OKANOGAN NATIONAL FOREST

Anadromous Fish and Bull Trout Habitat: Approximately 23 miles of bull trout occupied streams and 25 miles of anadromous fish occupied streams would be protected over that of the Proposed Action. These areas would have no effect on fish habitat. *The overall effect of the Expanded Protection Alternative would be the same as the Proposed Action: positive.*

Spotted Owl Habitat: This alternative would protect 23,000 acres in 2 of the 3 spotted owl critical habitat units, an increase of 5,000 acres over the Proposed Action. In addition, all spotted owl activity centers in host type, outside Wilderness, would be protected to prevent degradation of owl habitat: 0.7 mile radius; 5 centers; 3000 acres, some of which overlap critical habitat unit acreage. This is the same amount of spotted owl habitat proposed for protection in the Proposed Action. Parts of the Twisp River and Upper Methow Late Successional Reserves (16,600 acres) would be protected to prevent loss of late successional stands due to defoliation, mortality, and increased risk of wildfire. Several other LSRs in host type would be protected for other resource concerns. In addition, the expanded alternative protects from an outbreak of the tussock moth all 60-100% host type in the landscape. In total, about 77,000 acres of LSR would be protected (this acreage may overlap acreage in the critical habitat units and activity centers described above). This is an increase of about 28,000 acres over that of the Proposed Action.

Treatment in these Reserves would meet all standards and guidelines in the *1994 Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents In the Range of the Northern Spotted Owl* and the *1998 Okanogan Assessment of the Northeastern Cascades Late Successional Reserves*. The project proposal is consistent with these documents as they relate to treating Late Successional Reserves for control of a tussock moth outbreak.

Because aircraft could operate in the ¼ mile buffer of many activity centers between mid-June and mid-July, owls could be disturbed. The potential for disturbance with implementation of this alternative would be greater than the Proposed Action because protection could occur over more lands considered un-surveyed spotted owl habitat. *However, the overall effect of the Expanded Protection Alternative on spotted owl habitat would be positive.*

WENATCHEE NATIONAL FOREST

Anadromous Fish and Bull Trout Habitat: Approximately 7 miles of bull trout and anadromous fish occupied streams would be protected over that of the Proposed Action. These areas would have no effect on fish habitat. *The overall effect of the Expanded Protection Alternative would be the same as the Proposed Action: positive.*

Spotted Owl Habitat: This alternative would protect 80,000 acres in 10 of the 17 spotted owl critical habitat units on the Wenatchee National Forest. This would be an increase of 18,000 acres over that of the Proposed Action. As with the Proposed Action, all spotted owl activity centers in host type, outside Wilderness, would be protected to prevent degradation of owl habitat: 0.7 mile radius; 112 centers; 32,000 acres, some of which overlap critical habitat unit acreage. Similar to the Proposed Action, all host type in the following Late-Successional Reserves and Managed Late Successional Reserves would be protected to maintain spotted owl nesting, roosting, foraging and dispersal habitat: Upper Nile, Rattlesnake, Swauk, Deadhorse, Chiwawa, Shady Pass, Lucerne, DM-2, 3, 5, 6, 7, 10, 11 and 12. These LSRs and MLSRs have the greatest potential to be adversely impacted by defoliation and subsequent mortality. Several other LSRS and MLSRs would be protected to meet other resource objectives. In addition, the expanded alternative protects from an outbreak of the tussock moth all 60-100% host type. Thus, approximately 96,000 acres would be protected (this acreage may overlap acreage in the critical habitat units and activity centers described above).

Treatment would meet all standards and guidelines in the *1994 Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents In the Range of the Northern Spotted Owl* and the *1997 Wenatchee Assessment of the Northeastern Cascades Late Successional Reserves*. The project proposal is consistent with these documents as they relate to treating LSRs for control of a tussock moth outbreak.

Because aircraft could operate in the ¼ mile buffer of many activity centers between mid-June and mid-July, owls could be disturbed. This disturbance could include noise and prop-wash/down-draft caused by low-flying aircraft. Flight paths could cross directly overhead of an activity center, with additional flights alongside. Since most juvenile owls in host type on Wenatchee Forest fledge by late May/early June, would be in the rearing stage during project operations. Thus, they would have some ability to move away from the disturbance (J. Richards, pers. comm., 2000). However, other districts on the Wenatchee have activity centers that are proposed for protection that have later fledgling dates. Therefore, there is an increased potential that project aircraft would disturb these young prior to them being mobile. The frequency and location of operational flights in relation to the activity centers would be determined by the distribution and location of the tussock moth outbreak.

Although this alternative protects more acreage of spotted owl habitat than the Proposed Action, substantial increases in benefits to the owls are not expected. Most high-risk and important habitat is protected in the Proposed Action. *The overall effect of the Expanded Alternative on spotted owl habitat would be positive.*

UMATILLA NATIONAL FOREST

Anadromous Fish and Bull Trout Habitat: Protection areas and effects would be the same as in the Proposed Action.

Approximately 13,500 acres of riparian areas adjacent to critical habitat unit streams would be protected from an outbreak of the tussock moth. Stand and vegetative conditions would be maintained. The remaining 7,000 acres of high risk host type would remain vulnerable to a tussock moth outbreak. However, these areas vulnerable to DFTM are not predicted to be degraded if an outbreak occurred. *The overall effect of the Expanded Protection Alternative on fish habitat would be positive.*

Bald Eagle Habitat: Protection areas and effects would be the same as in the Proposed Action. *The overall effect of the Expanded Protection Alternative on bald eagle habitat would be positive.*

WALLOWA NATIONAL FOREST

Anadromous Fish Habitat: Another 342 miles would be protected over that of the Proposed Action. However, these additional areas would have no effect on anadromous fish habitat.

Approximately 80,000 acres of riparian areas adjacent to critical habitat unit designated streams would be protected from an outbreak of the tussock moth. Stand and vegetative conditions would be maintained. The remaining 16,000 acres of high risk host type would remain vulnerable to a tussock moth outbreak. However, these areas are not predicted to be degraded if an outbreak occurs. *The overall effect of the Expanded Protection Alternative would be the same as the Proposed Action: positive.*

Bull Trout Habitat: Twenty-one miles of streams would be protected in addition to the Proposed Action. These additional areas would have no effect on bull trout habitat. *The overall effect of the Expanded Protection Alternative on bull trout habitat would be the same as the Proposed Action: positive.*

MALHEUR NATIONAL FOREST

Anadromous Fish Habitat: Approximately 81 more miles of stream would be protected over that of the Proposed Action, but with no effect on anadromous fish habitat. *The overall effect of the Expanded Protection Alternative would be the same as the Proposed Action: positive.*

Bull Trout Habitat: This alternative would protect an additional 47 miles of stream over that of the Proposed Action. However, there would be no effect on bull trout habitat. *The overall effect of the Expanded Protection*

Alternative would be the same as the Proposed Action: positive.

OCHOCO NATIONAL FOREST

Anadromous Fish Habitat: Protection areas and effects would be the same as in the Proposed Action. *The overall effect of the Expanded Protection Alternative would be positive.*

WINEMA NATIONAL FOREST

Bull Trout Habitat: Lack of protection areas and effects would be the same as in the Proposed Action. *The overall effect of the Expanded Protection Alternative would be positive.*

Spotted Owl Habitat: This alternative would protect 29,000 acres in both of the spotted owl critical habitat units on the Winema Forest. Protection would be provided to 41 spotted owl activity centers on 2400 acres of host type outside Wilderness. Since all 60-100% DFTM host type would be protected, some of the areas would include Late Successional Reserves (35,000 acres). Treatment would meet all standards and guidelines in the *1994 Record of Decision for Amendments to Forest Service and Bureau of Land Management Planning Documents In the Range of the Northern Spotted Owl* and the *1998 South Cascades Late Successional Reserve Assessment*.

The potential for disturbance would be greater than the Proposed Action because protection could occur over more lands considered un-surveyed spotted owl habitat. Although this alternative protects more spotted owl habitat than the Proposed Action, substantial increases in benefits to owls is not expected. Reasons for this are explained in the No Action Alternative. *As with the Proposed Action, overall effect of the Expanded Alternative on spotted owl habitat would be positive.*

Bald Eagle Habitat: The expanded alternative would protect 1,400 acres of the 11,000 acres in designated eagle habitat. This would prevent defoliation that could have improved bald eagle habitat in the area. As a result, t*here would be a small negative effect on bald eagle habitat under the Expanded Protection Alternative, more so than in the Proposed Action.*

FREMONT NATIONAL FOREST

Bull Trout Habitat: Protection areas and effects would be the same as in the Proposed Action. *The overall effect of the Expanded Protection Alternative would be positive.*

Effects Determination Summary

Anadromous Fish: **No Effect** – Okanogan National Forest. **May Affect, Not Likely to Adversely Affect (Beneficial Impact)** – Wenatchee, Wallowa-Whitman, Umatilla, Malheur, and Ochoco National Forests (see Proposed Action).

Bull Trout: **No Effect** – Ochoco and Winema National Forests. **May Affect, Not Likely to Adversely Affect (Beneficial Impact)** – Okanogan, Wenatchee, Wallowa-Whitman, Umatilla, Malheur, and Fremont National Forests (see Proposed Action).

Spotted Owl: **May Affect, Likely to Adversely Affect** – Okanogan, Wenatchee, Winema National Forests (see Proposed Action).

Bald Eagle: **No Effect** – Colville, Okanogan, Wenatchee, Wallowa-Whitman, Malheur, and Fremont National Forests (see Proposed Action). **May Affect, Not Likely To Adversely Affect** – Ochoco and Winema National Forests (see Proposed Action). **May Affect, Likely to Adversely Affect** – Umatilla National Forest (see Proposed Action).

TM-BIOCONTROL ONLY ALTERNATIVE

ALL FORESTS

Anadromous Fish and Bull Trout Habitat: All of the same streams protected in the Proposed Action also would be treated with TM BioControl only and would be protected in this alternative. Therefore, effects for this alternative are the same as those for the Proposed Action for all Forests.

COLVILLE NATIONAL FOREST

Bull Trout Habitat: *No effect*.

OKANOGAN NATIONAL FOREST

Anadromous Fish and Bull Trout Habitat: *Positive effect*.

Spotted Owl Habitat: Treatment area and effects same as Proposed Action. *The overall effect of the TM-BioControl Only Alternative on spotted owl habitat would be positive.*

WENATCHEE NATIONAL FOREST

Anadromous Fish and Bull Trout Habitat: *Positive effect.*

Spotted Owl: Treatment area and effects same as Proposed Action. *The overall effect of the TM-BioControl Only Alternative on spotted owl habitat would be positive.*

UMATILLA NATIONAL FOREST

Anadromous Fish and Bull Trout Habitat: *Same as Proposed Action. Positive effects.*

Bald Eagle Habitat: Protection areas and effects would be the same as in the Proposed Action. *The overall effect of the TM-BioControl Only Alternative on bald eagle habitat would be positive.*

WALLOWA-WHITMAN NATIONAL FOREST

Anadromous Fish and Bull Trout Habitat: *Positive effect*.

MALHEUR NATIONAL FOREST

Anadromous Fish and Bull Trout Habitat: *Positive effect*.

OCHOCO NATIONAL FOREST

Anadromous Fish Habitat: *Positive effect*.

WINEMA NATIONAL FOREST

Bull Trout Habitat: Positive effect.

Spotted Owl Habitat: Protection areas and effects would be the same as in the Proposed Action. *The overall effect of this alternative on spotted owl habitat would be positive.*

Bald Eagle Habitat: Protection areas and effects would be the same as in the Proposed Action. *There would be a small negative effect under the TM-BioControl Only Alternative.*

FREMONT NATIONAL FOREST

Bull Trout Habitat: *Positive Effect.*

Effects Determination Summary

Anadromous Fish: **No Effect** – Okanogan National Forest. **May Affect, Not Likely to Adversely Affect (Beneficial Impact)** – Wenatchee, Wallowa-Whitman, Umatilla, Malheur, and Ochoco National Forests (see Proposed Action).

Bull Trout: **No Effect** – Ochoco and Winema National Forests. **May Affect, Not Likely to Adversely Affect (Beneficial Impact)** – Okanogan, Wenatchee, Wallowa-Whitman, Umatilla, Malheur, and Fremont National Forests (see Proposed Action).

Spotted Owl: **May Affect, Likely to Adversely Affect** – Okanogan, Wenatchee, Winema National Forests (see Proposed Action).

Bald Eagle: **No Effect** – Colville, Okanogan, Wenatchee, Wallowa-Whitman, Malheur, and Fremont National Forests (see Proposed Action). **May Affect, Not Likely To Adversely Affect** – Ochoco and Winema National Forests (see Proposed Action). **May Effect, Likely to Adversely Affect** – Umatilla National Forest (see Proposed Action).

FISH & WILDLIFE: OTHER THREATENED AND ENDANGERED SPECIES

NO ACTION

ALL FORESTS

Lynx Habitat: If there was a DFTM outbreak on any of the eight national Forests with documented or suspected occurrences of lynx, defoliation and subsequent mortality would probably not affect lynx habitat. Generally, outbreaks are predicted for dry-site environments at low elevations, whereas lynx habitat typically occurs at high elevation with lodgepole pine, Englemann spruce, and subalpine fir. The majority of potential defoliation and subsequent mortality caused by a tussock moth outbreak would not occur in lynx habitat. *This alternative would have no effect on lynx habitat.*

COLVILLE NATIONAL FOREST

Caribou Habitat: If a DFTM outbreak occurred in the northeast corner of the Colville National Forest, defoliation and subsequent mortality could cause a slight degradation of caribou habitat. A loss of canopy closure in stands could occur that are providing cover for caribou. A high canopy closure is essential in the winter because it intercepts snow and makes ground foraging easier. Canopy closure is also beneficial in the summer because it offers protection from the heat. *Implementation of the No Action Alternative could have a small negative effect on caribou habitat.*

Gray Wolf Habitat: Potential rendezvous or den sites would not be affected by a tussock moth outbreak. Defoliation could reduce canopy closure, possibly causing a reduction in the snow-intercept thermal cover, thermal cover, and lichen habitat favored by ungulate prey species. However, a reduction in canopy closure could also improve understory forage for prey species in outbreak areas. Calving and fawning areas could be reduced in number and quality due to the loss of cover from defoliation and subsequent stand mortality. There would be no change in human/wolf interaction. *In conclusion, the No Action Alternative could have both benefits and consequences to the prey base for the gray wolf.*

Grizzly Bear Habitat: Defoliation and subsequent mortality could improve grizzly bear habitat by creating additional open-structure stands, which provide grizzly bear food sources. There would be no change in human/grizzly bear interaction or disturbance. *The effect of the No Action Alternative on grizzly bear habitat would be positive.*

OKANOGAN NATIONAL FOREST

Gray Wolf Habitat: Potential rendezvous or den sites would not be affected by a tussock moth outbreak. Defoliation could also reduce canopy closure, possibly causing a reduction in the snow-intercept thermal cover, thermal cover, and lichen habitat favored by ungulate prey species. However, a reduction in canopy closure could also improve understory forage for prey species in outbreak areas. Calving and fawning areas could be reduced in number and quality due to the loss of cover from defoliation and subsequent stand mortality. There would be no change in human/wolf interaction. In conclusion, the No Action Alternative could have both benefits and consequences to the prey base for the gray wolf.

Grizzly Bear Habitat: Defoliation and subsequent mortality could improve grizzly bear habitat as mentioned for the Colville. *The effect of this alternative on grizzly bear habitat would be positive.*

WENATCHEE NATIONAL FOREST

Gray Wolf Habitat: Potential or known rendezvous or denning sites would not be affected by a tussock moth outbreak. Defoliation could also reduce canopy closure, possibly causing a reduction in the snow-intercept thermal cover, thermal cover, and lichen habitat favored by ungulate prey species. However, a reduction in canopy closure could also improve understory forage for prey species in outbreak areas. Calving and fawning areas could be reduced in number and quality due to the loss of cover from defoliation and subsequent stand mortality. There would be no change in human/wolf interaction. *In conclusion, the No Action Alternative could have both*

benefits and consequences to the prey base for the gray wolf.

Grizzly Bear Habitat: Defoliation and subsequent mortality could improve grizzly bear habitat as mentioned for the Colville. *The effect of this alternative on grizzly bear habitat would be positive.*

Marbled Murrelet: Host type for the Douglas-fir tussock moth does not occur in the areas where incidental sightings of the marbled murrelets have been made on the Wenatchee. *This No Action Alternative would have no effect on marbled murrelet habitat.*

WINEMA NATIONAL FOREST

Shortnose or Lost River Sucker Habitat: No host type for the Douglas-fir tussock moth occurs in or adjacent to sucker habitat. The No Action Alternative would have no effect on sucker habitat.

FREMONT NATIONAL FOREST

Shortnose or Lost River Sucker Habitat: No host type for the Douglas-fir tussock moth occurs in or adjacent to sucker habitat. The No Action Alternative would have no effect on sucker habitat.

Warner Sucker Habitat: No host type occurs in or adjacent to Warner Sucker habitat. Defoliation and subsequent mortality would not have the potential to affect the fish or its habitat. There would be no effect on Warner Sucker habitat from the No Action Alternative.

OTHER FORESTS

There are no other threatened or endangered species on the Umatilla, Wallowa-Whitman, Malheur, or Ochoco Forests in the project area.

Effects Determination Summary

Caribou: **May Effect, Not Likely to Adversely Affect**. There is a potential loss of caribou habitat from DFTM outbreak.

Gray Wolf: **May Effect, Not Likely to Adversely Affect.** There is potential for a reduction in habitat of prey species.

Grizzly Bear: **May Effect, Not Likely to Adversely Affect (Beneficial Impact).** A beneficial effect is possible due to the potential for an increase in food resources for the grizzly bear.

Lynx: **No Effect.**

Shortnose and Lost River Suckers: **No Effect.**

Warner Sucker: **NoEffect.**

PROPOSED ACTION

ALL FORESTS

Lynx: The proposed protection areas are generally not in lynx habitat. *Therefore, this alternative is not expected to have any effects on lynx.*

COLVILLE NATIONAL FOREST

Caribou Habitat: Protection is not proposed in caribou habitat on the Colville National Forest. The closest potential protection sites is on the west banks of Sullivan Lake, one-half mile from the known caribou habitat on the Forest. *The Proposed Action would have no effect on caribou habitat.*

Gray Wolf Habitat: Although the entire Forest is considered potential habitat for gray wolf, the areas protected under the Proposed Action do not provide quality habitat due to high road densities and human disturbances. Since wolf rendezvous and den sites would be active during the proposed treatment period, there is the potential, although small, that an unknown or new rendezvous or den site could occur in or adjacent to protection areas.

Protection from defoliation could prevent a loss of canopy closure, which could have led to a reduction in the snow-intercept thermal, thermal cover, and lichen habitat favored by prey ungulates. Protection of these sites could also prevent improvement of understory forage in areas where it is currently deficient. Protection would maintain calving and fawning areas.

There would be no measurable increase in wolf/human interaction and no change in road density. Project operations could create a noise disturbance. If a wolf happened to be present in an area being treated, any potential disturbance is predicted to be short-term and inconsequential. The duration of flyovers would be of short; only one application is proposed; low-flying aircraft traveling at 90 mi/hr and applying pesticide at 50-75 feet above the canopy would make only a few passes for any particular treatment area. In conclusion, the potential for lasting disturbance to any wolf from project operations is unlikely.

In conclusion, prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.

Grizzly Bear Habitat: The larvae stage of the army cutworm moth is known to be highly susceptible to B.t.k. The moth is in its larvae stage in eastern Washington, most likely in the Palouse region (B. Noble, per. com. 1999). It is thought to enter its adult stage in this area and then migrate to the Cascades in the late spring/early summer. The moth would only be in its adult stage when it is present in the project area. B.t.k. targets the larval stage of Lepidoptera susceptible species. It is unlikely that B.t.k. would affect the adult army cutworm in the project area, and thus is unlikely to impact this potential food supply for the grizzly.

No other bear habitat features (space, isolation, denning, sanitation, safety) would be affected by project implementation. By preventing defoliation in areas proposed for protection, the existing vegetation, stand structure, and food sources would remain unchanged. If treatment occurs in or near an area where a grizzly bear is

present, there is the potential that operational aircraft could disturb bears. However, any disturbance is likely to be short-term and inconsequential for the reasons cited previously for wolves. *There would be no effect of the Proposed Action on grizzly bear habitat.*

OKANOGAN NATIONAL FOREST

Gray Wolf Habitat: Protection is proposed in areas of the Methow Ranger District that have had documented presence of wolves. Some of these areas are relatively isolated with low road densities. These are the places most likely to provide adequate habitat for the species. At these sites, there is the small potential for disturbance to wolves caused by project aircraft.

Protection from defoliation could prevent a loss of canopy closure, which could lead to a reduction in the snow-intercept thermal, thermal cover, and lichen habitat favored by prey ungulates. Protection of these sites could also prevent improvement of understory forage in areas where it is currently deficient. Protection would maintain calving and fawning areas at the treatment sites.

There would be no measurable increase in wolf/human interaction and no change in road density. Project operations could create a noise disturbance. If a wolf happened to be present in an area being treated, any potential disturbance is predicted to be short-term and inconsequential. The duration of flyovers would be of short; only one application is proposed; low-flying aircraft traveling at 90 mi/hr and applying pesticide at 50-75 feet above the canopy would make only a few passes for any particular treatment area.

In conclusion, prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.

Grizzly Bear Habitat: As mentioned previously for the Colville effects, the Proposed Action is not expected to have any effect on grizzly bear habitat components, including army cutworm moth populations. By preventing defoliation in areas proposed for protection, the existing vegetation, stand structure, and food sources would remain unchanged. Any disturbance from aerial operations is likely to be short-term and inconsequential for the reasons cited previously for wolves. *The Proposed Action would have no effect on grizzly bear habitat.*

WENATCHEE NATIONAL FOREST

Gray Wolf Habitat: Treatment is proposed near areas known to have documented presence of wolves. Some of these are relatively isolated with low road densities, and thus, provide adequate habitat for the species. The two known rendezvous sites on the Wenatchee National Forest are located more than five miles west of any of the proposed protection areas.

Protection from defoliation could prevent a loss of canopy closure, which could lead to a reduction in the snow-intercept thermal, thermal cover, and lichen habitat favored by prey ungulates. Protection of these sites could also prevent improvement of understory forage in areas where it is currently deficient. Protection would maintain calving and fawning areas at the treatment sites.

There would be no measurable increase in wolf/human interaction and no change in road density. Project operations could create a noise disturbance. If a wolf happened to be present in an area being treated, any potential disturbance is predicted to be short-term and inconsequential. The duration of flyovers would be of short; only one application is proposed; low-flying aircraft traveling at 90 mi/hr and applying pesticide at 75' above the canopy would make only a few passes for any particular treatment area.

In conclusion, prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.

Grizzly Bear Habitat: As mentioned previously Colville effects, the Proposed Action is not expected to have any effect on grizzly bear habitat components, including army cutworm moth populations. By preventing defoliation in areas proposed for protection, the existing vegetation, stand structure, and food sources would remain unchanged. Any disturbance from aerial operations is likely to be short-term and inconsequential for the reasons cited previously for wolves. *This Proposed Action would have no effect on grizzly bear habitat.*

Marbled Murrelet Habitat: The Proposed Action would not occur in suspected habitat for the murrelet. *There would be no effect on marbled murrelet habitat.*

WINEMA NATIONAL FOREST

Shortnose and Lost River Sucker Habitat: Proposed protection areas occur well to the west of Klamath Basin, the location of the closest known population of Shortnose and Lost River Suckers. *The Proposed Action would have no effect on sucker habitat.*

FREMONT NATIONAL FOREST

Shortnose Sucker and Lost River Sucker: Some proposed protection areas are in the Lost River Basin, about 10-12 miles upstream from Shortnose and Lost River sucker habitat. Protection of these areas would not affect aquatic environments. *The Proposed Action would have no effect on sucker habitat.*

Warner Sucker Habitat: Proposed protection areas occur outside and to the west of Warner Sucker habitat. Located in a different watershed, there is no potential for downstream effects either. *The Proposed Action would have no effect on Warner Sucker habitat.*

OTHER FORESTS

There are no other threatened or endangered species on the Umatilla, Wallowa-Whitman, Malheur, or Ochoco Forests in the project area.

Effects Determination Summary

Caribou: **No Effect –Colville National Forest.** There is no proposed treatment in caribou habitat on the Colville National Forest. The closest treatment block occurs on the west banks of Sullivan Lake, just outside by about .5 miles of the known caribou habitat on the Forest.

Gray Wolf: **May Affect, Not Likely to Adversely Affect.** There is a small chance of disturbance to known or unknown rendezvous sites from operation of low-flying aircraft. In the unlikely event that disturbance does occur, it is predicted to be short term and inconsequential due to the duration of the flight.

Grizzly Bear: **May Affect, Not Likely to Adversely Affect** - Because of the small chance of a disturbance to grizzly bears from operation of low-flying aircraft, there could be a slight negative effect. In the unlikely event that disturbance does occur, it is predicted to be short term and inconsequential due to the duration of the flight.

Lynx: **No Effect –** Generally, proposed protection blocks are in dry site environments at low elevations. Lynx habitat typically occurs in high elevation stands of lodgepole pine, Englemann spruce, and subalpine fir. The majority of proposed treatment sites would not occur in lynx habitat.

Shortnose and Lost River Suckers: **No Effect**

Warner Sucker: **No Effect**

EXPANDED PROTECTION ALTERNATIVE

ALL FORESTS

Lynx: The proposed protection areas are generally not in lynx habitat. *Therefore, this alternative is not expected to have any effects on lynx.*

COLVILLE NATIONAL FOREST

Caribou Habitat: If an outbreak of the tussock moth occurred in the northeast corner of the Colville National Forest, protection could occur in caribou habitat. Protection could prevent loss of canopy closure in stands currently providing cover for caribou. High canopy closure is essential for intercepting snow and making ground foraging easier in the winter and offering protection from heat in the summer. Implementation of this alternative could prevent degradation of these habitat components. Aerial operations could create a noise disturbance. However, if caribou happened to be present in the area being treated, the potential disturbance is predicted to be short-term and inconsequential for the reasons cited previously for wolves. The potential for lasting disturbance to caribou from operation of low-flying aircraft is unlikely. *In conclusion, the overall effect of the Expanded Protection Alternative on caribou habitat is positive.*

Gray Wolf Habitat: Potential protection areas occur throughout the entire Forest, including the Pend Oreille Valley and Selkirk Mountains. Most wolf sightings on the Colville have occurred in these two places. This alternative could prevent a much greater loss of canopy closure, thermal cover, and lichen habitat than the Proposed Action. Increased protection could also prevent greater improvement of understory forage by maintaining canopy closure. There could also be an increased chance of disturbance to the wolves due to more extended aerial operations. However, any disturbance would still be short-term and inconsequential for the reasons stated in the Proposed Action.

In conclusion, prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.

OKANOGAN NATIONAL FOREST

Gray Wolf Habitat: Protection is proposed in areas of the Methow Ranger District that have documented presence of wolves. This alternative could also prevent a much greater loss of canopy closure, thermal cover, and lichen habitat than the Proposed Action. Increased protection could also prevent greater improvement of understory forage by maintaining canopy closure. There could also be an increased chance of disturbance to the wolves due to more extended aerial operations. However, any disturbance would still be short-term and inconsequential for the reasons stated in the Proposed Action.

In conclusion, prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.

Grizzly Bear Habitat: Similar to the Proposed Action, the Expanded Protection alternative is not expected to have any effect on grizzly bear habitat components, including army cutworm moth populations. By preventing defoliation in areas proposed for protection, the existing vegetation, stand structure, and food sources would remain unchanged. Any disturbance from aerial operations is likely to be short-term and inconsequential for the reasons cited previously for wolves. *This Expanded Protection Alternative would have no effect on grizzly bear habitat.*

WENATCHEE NATIONAL FOREST

Gray Wolf Habitat: Protection areas and effects would be the same as in the Proposed Action. *In conclusion, prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.*

Grizzly Bear Habitat: As mentioned previously, the Proposed Action is not expected to have any effect on grizzly bear habitat components, including army cutworm moth populations. By preventing defoliation in areas proposed for protection, the existing vegetation, stand structure, and food sources would remain unchanged. Any disturbance from aerial operations is likely to be short-term and inconsequential for the reasons cited previously

for wolves. *This Expanded Protection Alternative would have no effect on grizzly bear habitat.*

Marbled Murrelet Habitat: Effects same as Proposed Action. *The Expanded Protection Alternative would have no effect on marbled murrelet habitat.*

WINEMA NATIONAL FOREST

Shortnose and Lost River Sucker Habitat: Proposed protection areas occur well to the west of Klamath Basin, the location of the closest known population of Shortnose and Lost River Suckers. *This alternative would have no effect on sucker habitat.*

FREMONT NATIONAL FOREST

Shortnose Sucker and Lost River Sucker: Some proposed protection areas are in the Lost River Basin, about 10-12 miles upstream from Shortnose and Lost River sucker habitat. Protection of these areas would not affect aquatic environments. *This alternative would have no effect on sucker habitat.*

Warner Sucker Habitat: Proposed protection areas occur outside and to the west of Warner Sucker habitat. Located in a different watershed, there is no potential for downstream effects either. *This alternative would have no effect on Warner Sucker habitat.*

OTHER FORESTS

There are no other threatened or endangered species on the Umatilla, Wallowa-Whitman, Malheur, or Ochoco Forests in the project area.

Effects Determination Summary

Caribou: **May Affect, Not Likely to Adversely Affect** (see Proposed Action).

Gray Wolf: **May Affect, Not Likely to Adversely Affect** (see Proposed Action.

Grizzly Bear: **May Affect, Not Likely to Adversely Affect** (see Proposed Action.

Lynx: **No Effect.**

Shortnose and Lost River Suckers: **No Effect.**

Warner Sucker: **No Effect.**

TM-BIOCONTROL ONLY ALTERNATIVE

ALL FORESTS

Lynx: The proposed protection areas are generally not in lynx habitat. *Therefore, this alternative is not expected to have any effects on lynx.*

COLVILLE NATIONAL FOREST

Caribou: There are no proposed protection areas in caribou habitat under this alternative; *there would be no effect on caribou habitat.*

Gray Wolf Habitat: Protection areas and effects would be the same as in the Proposed Action. *Prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.*

OKANOGAN NATIONAL FOREST

Gray Wolf Habitat: Protection areas and effects would be the same as in the Proposed Action. *Prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.*

Grizzly Bear Habitat: Protection areas and effects would be the same as in the Proposed Action. *There would be no effect from implementation of the TM-BioControl Only Alternative.*

WENATCHEE NATIONAL FOREST

Gray Wolf Habitat: Protection areas and effects would be the same as in the Proposed Action. *Prevention of defoliation could have both positive and negative benefits to the prey base for wolves. Any disturbance to the wolf is predicted to be short term and inconsequential.*

Grizzly Bear Habitat: Protection areas and effects would be the same as in the Proposed Action. *There would be no effect from implementation of the TM-BioControl Only Alternative.*

Marbled Murrelet Habitat: Protection areas and effects would be the same as in the Proposed Action. *There would be no effect from implementation of the TM-BioControl Only Alternative.*

WINEMA NATIONAL FOREST

Shortnose and Lost River Sucker Habitat: Proposed protection areas occur well to the west of Klamath Basin, the location of the closest known population of Shortnose and Lost River Suckers. *This alternative would have no effect on sucker habitat.*

FREMONT NATIONAL FOREST

Shortnose Sucker and Lost River Sucker: Some proposed protection areas are in the Lost River Basin, about 10-12 miles upstream from Shortnose and Lost River sucker habitat. Protection of these areas would not affect aquatic environments. *This alternative would have no effect on sucker habitat.*

Warner Sucker Habitat: Proposed protection areas occur outside and to the west of Warner Sucker habitat. Located in a different watershed, there is no potential for downstream effects either. *This alternative would have no effect on Warner Sucker habitat.*

OTHER FORESTS

There are no other threatened or endangered species on the Umatilla, Wallowa-Whitman, Malheur, or Ochoco Forests in the project area.

Effects Determination Summary

Caribou: **May Affect, Likely to Adversely Affect** (see Proposed Action).

Gray Wolf: **May Affect, Not Likely to Adversely Affect** (see Proposed Action.

Grizzly Bear: **May Affect, Not Likely to Adversely Affect** (see Proposed Action.

Lynx: **No Effect.**

Shortnose and Lost River Suckers: **No Effect.**

Warner Sucker: **No Effect.**

FISH AND WILDLIFE: SENSITIVE SPECIES

In 1995, the Regional Foresters from the Pacific Northwest, Intermountain, and Northern Regions of the Forest Service issued direction that standardized the terminology used to describe effects of actions and projects to sensitive species. The terminology is defined as follows:

- No Impact ("NI"): A project or activity will have no environmental effect on habitat, individuals, a population, or a species.
- May Impact Individuals Or Habitat But Will Not Likely Contribute To A Trend Towards Federal Listing or Cause A Loss Of Viability To The Population Or Species ("MIIH"): Activities or actions that have effects that are immeasurable, minor or are consistent with Conservation Strategies would receive this conclusion. For populations that are small - or vulnerable - each individual may be important for short and long-term viability.
- Will Impact Individuals Or Habitat With A Consequence That The Action May Contribute To A Trend Towards Federal Listing Or Cause A Loss Of Viability To The Population or Species ("WIFV"): Loss of individuals or habitat can be considered significant when the potential effect may: 1) Contributing to a trend toward Federal listing; 2) Result in a significantly increased risk of loss of viability to a species; or, 3) Result in a significantly increased risk of loss of viability to a significant population (stock).
- Beneficial Impact ("BI"): Projects or activities that measurably benefit a sensitive species.

Table IV-6, below, provides a summary of the effects to sensitive species of animals. The rationale for the effects determination, identified by superscripts, follows.

Table IV-6: Summary of Effects, Sensitive Fish & Wildlife Species

SPECIES	NO ACTION ALT.	PROPOSED ACTION	EXPANDED PROTECTION ALT.	TM-BIOCONTROL ONLY ALT.
Interior redband trout	NI 3	MIIH 1	MIIH 1	NI 3
Oregon Lakes tui chub	NI 3	MIIH 1	MIIH 1	NI 3
Goose Lake Sucker	NI 3	MIIH 1	MIIH 1	NI 3
Klamath largescale sucker	NI 3	MIIH 1	MIIH 1	NI 3
Malheur mottled sculpin	NI 3	MIIH 1	MIIH 1	NI 3
Pit sculpin	NI 3	MIIH 1	MIIH 1	NI 3
Slender sculpin	NI 3	MIIH 1	MIIH 1	NI 3
Mid Col. Fall Chinook salmon	MIIH	MIIH	MIIH	MIIH
Mid Col. Sp. Chinook salmon	MIIH	MIIH	MIIH	MIIH
Larch Mountain Salamander	NI 5	MIIH 2	MIIH 2	NI 3
Oregon Spotted Frog	NI 5	MIIH 2	MIIH 2	NI 3
Columbia Spotted Frog	NI 5	MIIH 2	MIIH 2	NI 3
Northern red-legged frog	NI 5	MIIH 2	MIIH 2	NI 3
Northwestern pond turtle	NI 5	MIIH 2	MIIH 2	NI 3
Common loon	NI 1	NI 1	NI 1	NI 1
American white pelican	NI 1	NI 1	NI 1	NI 1
Ferruginous hawk	NI 1	NI 1	NI 1	NI 1
Am. Peregrine Falcon	NI 7	NI 1	NI 7	NI 7
Western sage grouse	NI 1	NI 1	NI 1	NI 1
Greater sandhill crane	NI 1	NI 1	NI 1	NI 1
Long-billed curlew	NI 1	NI 1	NI 1	NI 1
Upland sandpiper	NI 1	NI 1	NI 1	NI 1
Tricolored blackbird	NI 1	NI 1	NI 1	NI 1
Harlequin duck	NI 6	NI 6	NI 6	NI 6
Yellow rail	NI 1	NI 1	NI 1	NI 1
Black rosy finch	NI 1	NI 1	NI 1	NI 1
Preble's shrew	NI	MIIH	MIIH	MIIH
Pacific western big-eared bat	BI	WIFV	WIFV	MIIH
Pygmy rabbit	NI 1	NI 1	NI 1	NI 1
California wolverine	NI 4	NI 4	NI 4	NI 4
California bighorn sheep	NI 4	NI 4	NI 4	NI 4
Schuh's homoplectran caddisfly	NI 2	NI 2	NI 2	NI 2
Cascades apatanian caddisfly	NI 2	NI 2	NI 2	NI 2
Blue Mountain cryptochian caddisfly	NI	MIIH	MIIH	NI
Ft. Dick limnephilus caddisfly	NI 2	NI 2	NI 2	NI 2

Rationale for Determinations of Effects

NI – No Impact

Where there are no impacts to sensitive species, the rationales for such determinations have been categorized. The categories consist of species similarly affected by a particular alternative because of habitat associations, ecological niches, or distribution in the planning area.

NI 1. Species habitat is outside DFTM host type. These species are found in marshlands, alpine environments, sagebrush flats, forest/grassland interfaces, grasslands, or non-montane meadows. These habitats would not be protected under any alternative.

NI 2. Species may occur in or adjacent to forested stands that contain DFTM host types but are NOT in areas proposed for protection.

NI 3. Species may occur in or adjacent to forested stands that contain DFTM host types. They are NOT sensitive to potentially small, immeasurable changes in stream temperature caused by the predicted levels of defoliation or tree mortality. These species are not expected to benefit from the abundance of tussock moths because of a varied diet that includes only minor amounts of Lepidopterans. Use of TM BioControl would reduce only tussock moth populations, keeping total Lepidopteran biomass near baseline conditions. Therefore, there would be no impact.

NI 4. Species are unaffected by defoliation or tree mortality. B.t.k. or TM BioControl does not affect these species nor are they affected by relative abundance of Lepidoptera as a food source.

NI 5. Species are unaffected by defoliation or tree mortality; they may feed on Lepidoptera. If so, they would probably not benefit from high populations of Douglas fir tussock moth. Treatment with TM BioControl would reduce only tussock moth populations.

NI 6. The harlequin duck is known to nest in cavities along and adjacent to streams in forests. It feeds primarily on aquatic animals. It is not affected by B.t.k. or TM BioControl and would not benefit from high populations of Douglas fir tussock moth. There could be very slight but immeasurable benefits from increased tree mortality, but the differences between alternatives is not great enough to warrant different determinations of effects.

NI 7. Expected levels of defoliation or tree mortality would not affect Peregrine falcons; they do not feed on Lepidoptera but could slightly benefit from increased numbers of insectivorous birds. B.t.k. or TM BioControl does not affect peregrine falcons. Since they are susceptible to disturbance by helicopters, one-mile buffers have been prescribed for eyrie sites. These buffers allow a determination of "No Impact".

MIIH – May Impact Individuals or Habitat, But Will Not Likely Contribute To A Trend Towards Federal Listing or Cause A Loss Of Viability To The Population Or Species

MIIH 1. Species may occur in or adjacent to forested stands that contain DFTM host types. They are NOT sensitive to potentially small, immeasurable changes in stream temperature caused by the predicted levels of defoliation or tree mortality.

MIIH 2. B.t.k. could reduce Lepidoptera populations, reducing potential food sources of these species. There is also a limited risk of a negative effect on other aquatic insects (Eidt, 1985; Lacey and others, 1978; Kreutzweiser and others, 1992 & 1993; all cited in USDA, 1995). Because Lepidoptera comprise only a small portion of the diets of these species and protection would not be uniform across the landscape, there should not be impacts to the species that would result in a trend toward Federal listing or a loss of viability.

MIIH 3. Species may derive a small portion of their food supply from Lepidoptera but feed mostly on other fauna. Because of a varied diet and lack of dependence on Lepidoptera, they are also not likely to benefit from high populations of Douglas fir tussock moths. Use of TM-BioControl would not adversely impact the species. Use of B.t.k. could reduce local Lepidoptera populations and could adversely impact local populations of the wildlife species. Because they use a varied prey base and protection would not be uniform across the landscape, alternatives that include use of B.t.k. would not cause a loss of viability or trend toward Federal listing.

Other

Mid Columbia Fall and Spring Chinook Salmon: These stocks of salmon are subject to risks from the Douglas fir tussock moth outbreak and proposed protection. Under all alternatives, defoliation and mortality by DFTM could affect streamside shading and consequently, water temperatures. The No Action Alternative could result in the greatest loss of shading. However, based on the expected levels of defoliation in each of the risk categories and the predicted low mortality, overall shade reduction is expected to be small and patchy. Measurable increases in temperature are not expected. This minor, immeasurable effect would not cause a trend toward Federal listing or loss of viability. All other alternatives include unprotected areas in host type that could be defoliated. However, the affect of such defoliation would be less than that of the No Action Alternative; again, there would not be a trend toward Federal listing or a loss of viability.

Use of B.t.k. could result in the loss of significant portions of the Lepidopteran biomass in localized areas. There is some indication that B.t.k. could affect stoneflies or other aquatic insects (Eidt, 1985; et. al., cited in USDA, 1995). These effects could reduce salmon food supplies, adversely impacting fish species. Because of the limited riparian area that would be protected with B.t.k. under the Proposed Action and Expanded Protection Alternatives, potential effects would be small and would not rise to a level that would cause a trend toward Federal listing or a loss of viability.

It is unlikely that these salmon would benefit from large populations of tussock moth because of their varied prey base and lack of evidence that forage is a limiting factor under baseline conditions. Use of TM BioControl would reduce only tussock moth populations, keeping total Lepidopteran biomass near baseline conditions. No impact from a reduction in forage base is expected.

Preble's Shrew: Preble's shrews occur primarily in grasslands and sagebrush habitats. It is unlikely that it occurs in DFTM host type forests. Even if it did, it is unlikely there would be benefits or negative impacts from a tussock moth outbreak. The No Action Alternative would have no impact.

Use of B.t.k. in the Proposed Action could depress populations of Lepidoptera and could have minor impacts on the Preble's shrew food supply. Because the probability of the shrew occurring in protected host type is very small and the acreage to be protected is relatively

small, some individuals may be affected but there would not be a trend toward Federal listing or loss of viability if the Proposed Action were implemented. Protection of additional acreage in the Expanded Protection Alternative would also have little potential impact because of the low probability of Preble's shrew in host type. The effect would remain MIIH.

The use of TM-BioControl only would not affect the shrew's food supply and there is little likelihood the shrew is in host type. The effect would be no impact.

Townsend's Big-Eared Bat: Like many bats, Townsend's big-eared bats feed mostly on flying insects. Lepidoptera are an important and significant component of the prey base. The No Action Alternative could benefit the species, as a Douglas fir tussock moth outbreak could provide an abundant, easily accessible food source. This could lead to greater reproductive success and could contribute to overall viability of the species. The No Action Alternative would have a beneficial impact (BI) on Townsend's big-eared bat.

All other alternatives would have a negative impact on the species. Use of B.t.k. could reduce overall Lepidoptera populations. Because the Townsend's big-eared bat feeds so extensively on Lepidoptera, there could be serious impacts to its prey base in localized areas. Few areas proposed for protection have been adequately surveyed for Townsend's bat maternity roosts. If areas around a roost were treated with B.t.k. and Lepidoptera populations were significantly reduced, there could be adverse impacts to reproduction and adult bats. Because populations of Townsend's bat are already low, further reductions would likely contribute to a need to list the bat under the Endangered Species Act or cause a loss of viability. The effect of the Proposed Action and Expanded Protection Alternative would be WIFV.

Use of TM-BioControl only would have the least negative affect because of the small number of acres protected and because the impact is limited only to tussock moths. Other Lepidoptera populations would remain near baseline levels. Some individual bats may be affected but there would not be a trend toward Federal listing or loss of viability ("MIIH").

Blue Mountain Cryptochian Caddisfly: There is some indication that B.t.k. may kill stoneflies or other aquatic insects (Eidt, 1985; et. al., cited in USDA, 1995). It is prudent to assume that there could be mortality associated with using B.t.k. However, it also appears that the effects are slight and short duration; they should not cause significant adverse impacts. The overall effect of the Proposed Action and Expanded Protection Alternative would be MIIH.

The No Action Alternative would not cause significant increases in water temperature due to defoliation or tree mortality. Caddisflies are not thought to be ultra sensitive to small immeasurable changes in water temperature nor significantly affected by an abundance of tussock moths. TM BioControl has been shown to have no effect on aquatic insects. Thus, the No Action and TM BioControl Only Alternatives would not cause an impact (NI) to the caddisfly.

FISH AND WILDLIFE: "SURVEY AND MANAGE" SPECIES

Aerial treatment of tussock moth is not a ground-disturbing activity. However, to insure protection of the included species, an assessment of the effects on Survey and Manage Species was made for each alternative.

Mollusks: The No Action Alternative would probably have minimal effects on mollusks. Effects of defoliation and tree mortality, while largely unknown, are part of a natural cycle that should not have significant detrimental effects on mollusks. For all other alternatives, the EPA reported in 1998 that there were no effects from B.t.k. on oysters and mussels. Based on these results and the lack of effects to most other species, it is likely that B.t.k. will have no effect on Survey and Manage mollusks during this project. Studies (EPA, 1996) of the effects of TM-BioControl on non-target organisms found there were no effects to species other than tussock moths.

Larch Mountain Salamander: The No-Action alternative would probably not impact Larch Mountain salamanders because although they may eat tussock moths, their generalist feeding habits make them unlikely to benefit from an eruption of tussock moths. For alternatives using B.t.k., there could be a significant reduction of Lepidoptera populations in localized areas. Because Larch Mountain salamanders have a varied diet, it does not depend on Lepidoptera - any reduction of this potential food source would not significantly reduce the salamander population. The Proposed Action and Expanded Protection Alternative would probably affect some individuals but is not expected to cause a trend toward Federal listing or loss of viability. Use of TM-BioControl only would not significantly suppress the overall Lepidoptera population and therefore, would not affect Larch Mountain salamanders.

FISH AND WILDLIFE: OTHER SPECIES

NO ACTION ALTERNATIVE

ALL FORESTS

Barred Owl and Goshawk Habitat: Some barred owls and goshawks could be displaced by defoliation-induced mortality if the outbreak occurred in habitat occupied by these birds. This would probably amount to 1-2% of goshawk and barred owl territories in mixed conifer habitat in the Region. Some Forests could experience local impacts to these populations (less than 5 pairs). *Overall, the No Action Alternative would have a negative effect on barred owl and goshawk habitat.*

Flammulated Owl Habitat: These moth-eating birds could benefit from a tussock moth outbreak (McCallum, 1994). In addition to an increased food supply, flammulated owls could benefit from the creation of additional snags where nest trees are currently limited, if they were in small, scattered patches and if the snags were of sufficient size to provide nesting cavities. Where large blocks of mortality (>200 acres) occurred, flammulated owl habitat could be reduced. These old-growth birds prefer ponderosa pine and/or Douglas fir stands and avoid young-forest conditions (McCallum, 1994; Reynolds and Linkhart, 1987; 1992). Under this alternative, an overall reduction of 1% of the flammulated owl habitat is possible, with potentially larger impacts on a specific watershed or Forest. *Overall, the No Action Alternative would have both negative and positive effects on flammulated owl habitat.*

Mustelid Habitat: Martens and fishers could benefit from no action/protection; both are highly associated with the presence of snags. Scattered tree mortality could improve this habitat in all but the largest blocks. The population of flying squirrels (a major prey of martens) would probably also increase since they are snag dependent. A small, local increase in martens and fishers could occur because of this alternative. *The No Action Alternative would have a positive effect on mustelid habitat.*

Songbird Habitat: Several songbird species could benefit from increased food for 2-3 years under the No Action Alternative. These include ruby-crowned kinglet, Swainson's thrush, western wood pewee, Western tanager, chipping sparrow, and Hammond's flycatcher; more than 20 species of migrant and resident birds eat tussock moths (Torgersen and others, 1984). Several of these species have shown recent declines, particularly those that glean insects from foliage. During an outbreak, it is expected that some bird species would benefit from the increased food supply. That could improve reproductive success or enhance survival. However, after an outbreak, habitat conversion could result in as much as a 15% decline in songbird species associated with mature, dry, mixed conifer forest. For songbird species that rely on open conditions and/or earlier seral stages, there could be long-term benefits. *The overall effect of the No Action Alternative on songbird habitat would be both positive and negative.*

Woodpecker Habitat: The No Action Alternative could improve woodpeckers habitat. Tree mortality from defoliation could provide additional nesting and feeding sites for primary cavity dwelling species. Habitat could also improve for approximately 40 species of secondary cavity nesters that occur in this habitat (Thomas and others, 1979). In addition, the tussock moths and resultant bark beetles and woodborers would probably become woodpecker food. Scattered mortality of up to 15% of the dense, dry mixed conifer forest with a few large (up to 1000 acres) patches would benefit woodpeckers in these habitats. On any Forest, there could be a short-term population increase of as much as 10% for some species. *The overall effect of the No Action Alternative on woodpecker habitat would be positive.*

PROPOSED ACTION

ALL FORESTS

Barred Owl and Goshawk Habitat: Much of the barred owl and goshawk habitat would remain unprotected in the Proposed Action. Potential effects would be similar to those discussed in the No Action Alternative. In addition, birds could be disturbed by operational aircraft. *Overall, the Proposed Action would have a negative effect on barred owl and goshawk habitat.*

Flammulated Owl Habitat: Potential habitat losses described in the No Action Alternative would diminish from implementation of the Proposed Action. Large blocks of unprotected habitat could experience mortality and habitat loss, especially on the Wallowa-Whitman and Umatilla Forests. Snag increases could benefit flammulated owls where mortality is scattered. The use of B.t.k. could affect the moth food supply for about one year. Small, localized reductions in productivity and population density are possible. *The overall effect of the Proposed Action on flammulated owl habitat would be negative.*

Mustelid Habitat: Protection of forested stands could result in the creation of fewer snags for martens and fishers. However, most of their habitat would not be protected. These species would not be affected by changes in moth populations or aerial operations. *There would be a positive effect of the Proposed Action on mustelid habitat.*

Songbird Habitat: Songbirds could benefit from a DFTM outbreak, but mostly in unprotected areas. The availability of extra food supplies could help some species achieve higher reproductive success or enhance survival (Torgerson, pers. comm., 2000). Since the use of B.t.k. could reduce moth and butterfly populations, this alternative could have a negative effect on birds that eat these insects. The effect would be limited because proposed protection acres are not expected to be extensive and population rebound is expected to occur the following year (Miller, 1990b). In addition, up to 630,000 acres of habitat valuable for species that rely on mixed conifer

would be protected. The potential for habitat conversion and habitat displacement would be lessened. Potential effects from aerial operations are unknown. *The overall effect of the Proposed Action on songbird habitat is both positive and negative.*

Woodpecker Habitat: The Proposed Action would still allow creation of new woodpecker habitat. Extra food would be available in unprotected areas, resulting in a potential 8% increase in the population of some species. Use of B.t.k. would probably not have a measurable effect on woodpeckers because Lepidoptera are not a major part of their diet. Aerial operations would not affect woodpeckers. *The overall effect of the Proposed Action on woodpecker habitat would be positive.*

EXPANDED PROTECTION ALTERNATIVE

ALL FORESTS

Barred Owl and Goshawk Habitat: This alternative could protect barred owl and goshawk habitat in host type. Defoliation-related habitat losses and subsequent displacement could be substantially reduced. Aerial operations could impact young owls or hawks that are ready to fledge but the potential for lasting disturbance to any owl or goshawk from project operations is unlikely. *The overall effect of the Expanded Protection Alternative on barred owl and goshawk habitat would be positive.*

Flammulated Owl Habitat: Use of B.t.k. on a large number of acres could have a substantial negative affect on flammulated owls. A decrease in Lepidoptera could significantly affect flammulated owl food supplies (McCallum, 1994). Prey availability is essential for thermoregulation and survival on cold nights (Ligon, 1968; Webb, 1982). This important food source could be removed for at least one year in a large area. *The effect of the Expanded Protection Alternative on flammulated owl habitat would be negative.*

Mustelid Habitat: Protection of additional forested stands could result in the creation of few snags for martens and fishers. Neither martens nor fishers would be affected by changes in moth populations or aerial operations. *The overall effect of the Expanded Protection Alternative on mustelid habitat would be negative.*

Songbird Habitat: With protection of most host type, habitat conversions would be minimal. This could provide long-term stability for species that rely on dense, old, dry mixed conifer. Songbird species that rely on disturbance to provide younger seral stages would not benefit from this alternative. Use of B.t.k. could cause a loss of food for some foliage gleaning species, particularly the chipping sparrow, ruby-crowned kinglet, yellow-rumped warbler, and Townsend's warbler. These factors could reduce some songbird productivity and survivorship for 2-3 years. Species that prefer open habitats could also be negatively affected since some of their food could be lost and little habitat would be improved for them. *The overall effect of the Expanded Protection Alternative on songbird habitat is negative.*

Woodpecker Habitat: Protection of additional host type would allow much of the existing condition to continue. Unprotected areas could provide extra food and new woodpecker habitat might be created. Use of B.t.k. would probably not have a measurable effect on woodpeckers because Lepidoptera are not a major part of their diet. Aerial operations would not affect woodpeckers. *The overall effect of the Expanded Protection Alternative on woodpecker habitat would be positive.*

TM-BIOCONTROL ONLY ALTERNATIVE

ALL FORESTS

Barred Owl and Goshawk Habitat: Much of the barred owl and goshawk habitat would remain unprotected in this alternative. Potential effects would be similar to those discussed in the No Action Alternative. In addition, operational aircraft could disturb birds. *Overall, the TM-BioControl Only Alternative would have a negative effect on barred owl and goshawk habitat.*

Flammulated Owl Habitat: Much of the flammulated owl habitat would remain unprotected in this alternative. Potential effects would be similar to those discussed in the No Action Alternative. Operational aircraft could disturb birds. *The overall effect of the TM-BioControl Only Alternative on flammulated owl habitat would be both positive and negative.*

Mustelid Habitat: Protection of forested stands could result in the creation of fewer snags for martens and fishers. However, most of their habitat would not be protected. These species would not be affected by changes in moth populations or aerial operations. *There would be a positive effect this alternative on mustelid habitat.*

Songbird Habitat: Use of TM-BioControl only would significantly limit adverse affects on moth-eating birds. The effect of this alternative on unprotected areas would be similar to the No Action Alternative. Some species dependent on mixed conifer Forest could be displaced. Up to 300,000 acres of mixed conifer habitat could be protected, benefiting species dependant on those areas. Songbird response to aircraft is unknown. *The overall effect of the TM-BioControl Only Alternative would be positive.*

Woodpecker Habitat: Most of the woodpecker habitat in host type would not be protected from a DFTM outbreak in this alternative. The effect in unprotected areas would be similar to that described in the No Action Alternative. The effect in protected areas would be similar to the Proposed Action. *The overall effect of the TM-BioControl Only Alternative would be positive.*

LEPIDOPTERA: DOUGLAS-FIR TUSSOCK MOTH

Outbreaks of the Douglas-fir tussock moth occur periodically. Many people living in eastern Oregon remember the tussock moth outbreak of the early 1970s. Others relate concerns with the Douglas-fir tussock moth in the context of their experience with the western spruce budworm *Choristoneura occidentalis Freeman*, another major forest defoliator. It is important to understand the differences in biology and life histories of these two insects in order to address these concerns.

Frequent questions that arise when talking about potential spray projects include:

- What is the effectiveness of the proposed treatment in achieving objectives?
- Will insect populations rebound after treatment?
- What are the effects of treatment on natural predators and parasites?
- Will the treatment contribute to long-term resistance of the insect to the insecticide?

In order to address these questions, a review of information on past outbreaks and treatments, insect biology, and natural control factors was conducted. A summary is presented here; for more information, see Appendix B.

Douglas-fir tussock moth outbreaks occur periodically, approximately every 7-11 years (Mason and Luck, 1978; Swetnam, et. al., 1995; Mason, et. al., 1997). They usually last 3-4 years and then collapse. The collapse is dramatic, and insects are very rare and difficult to find during non-outbreak periods. The Douglas-fir tussock moth belongs to a category of *"fast-cycling"* insects. They differ from *"sustained cycle"* insects, such as the western spruce budworm (Shepherd, 1994). This difference determines the appropriateness and success of a proposed treatment. Characteristics of a "fast-cycling" insect include explosive populations, severe defoliation and mortality 1-2 years, and dramatic population collapses. A sustained-cycle insect outbreak builds up more slowly, lasting for a longer period. Severe damage appears only after a number of years of defoliation and impact is related more to duration of defoliation, rather than intensity of defoliation, as occurs in the Douglas-fir tussock moth (Shepherd, 1994). The Western spruce budworm feeds only on new growth. After several years, trees take on a defoliated appearance, as older needles are not replaced by newer ones. Young caterpillars feed individually; opportunity for disease to spread in populations is limited. Partial defoliation over a short period is not as detrimental, and may be somewhat beneficial. Outbreaks are thought to decline from lack of quality food and possibly weather related occurrence. Natural parasites and population increases are able to develop over time, in relation to budworm population increases.

By contrast, hungry Douglas-fir tussock moth larvae can completely defoliate a tree in months. This heavy defoliation in a short period often causes tree death or makes trees susceptible to secondary mortality. High numbers of individuals feeding together allows tussock moth diseases to spread quickly through populations. As a result, insect populations collapse from starvation and disease. Natural parasites and predators do not play a significant role in population collapse; but are largely responsible for maintaining endemic levels.

The Douglas-fir tussock moth virus is one of the most virulent viruses known (cited in Hughes, 1978), and its role in the collapse of DFTM outbreak populations is well documented. As early as a 1929outbreak in Idaho, Blach (1932) noticed the ground covered with living and dead caterpillars, many of which had died from starvation, or were apparently diseased. The virus has been reported in association with almost every outbreak since. The virus persists in the soil at very low levels between DFTM outbreaks. Even after over 40 years, soil samples from sheltered locations still contained enough active virus to infect tussock moth larvae. This suggests that the virus may be a natural component of the forest ecosystem for a long time, but is then reintroduced into the forest canopy during a subsequent outbreak. Tussock moth outbreaks have been controlled by the virus in areas where there has been no previously recorded outbreak; whether the virus is somehow transported there, or is residual from an outbreak from years before recording began, or is somehow maintained in the very low DFTM populations indigenous to that area, or a combination of these factors, is less sure.

Virus produced by different age classes varies. The virus produced in the early larval instars remains on the needles where other larvae are likely to encounter the virus. A larger amount of the virus is produced in older larvae and is subsequently incorporated into the duff when they die (Thompson and Scott, 1979). As older larvae die from virus infection, they hang head down, with their legs still attached to the foliage (see photo, right). After death, they fall to a lower branch or the forest floor. They usually rupture, and their liquefied body contents splatter into the organic litter on the forest floor or onto an adjacent branch (Thompson, 1978).

Figure IV-2: Dead larvae

Two distinct nucleopolyhedrosis viruses ("NPVs") affect DFTM and a few other members of the *Orgyia* genus. One is a single rod virus and the other is a bundled rod virus. Both are highly infectious. The bundled rod virus appears to be slightly more infectious and was the one selected for development as TM BioControl (Hughes, 1978). The viruses are infective to all instars. Pupae frequently die, presumably because they were infected late in the larval life. The virus does not seem to affect adults. Complete resistance of tussock moth has not been found, either in extensive laboratory rearing or in field populations.

Undoubtedly the virus is the most important natural cause of the frequently observed, dramatic decline of Douglas-fir tussock moth populations that characteristically terminates a major outbreak. If the virus were not present in such situations, it is likely that other control factors would take over, although the response would be slower and they would not exert their influence as quickly as the virus. The virus does not appear to be a significant factor in endemic populations or sporadic flare-ups. Other factors, usually a complex of parasites, apparently act significantly on populations during these situations (Wickman, et. al., 1973; Mason, et. al., 1983). A solitary egg parasite, *Telenomus californicus*, is the most dominant and extremely efficient parasite; even when hosts are sparse over 90% of the egg masses may be destroyed. A Diptera parasite, *Agria housei*, is a significant parasite of cocoons, sometimes causing 64-96% cocoon mortality (Torgersen, 1981). There are about 88 species of parasites attacks various life stages of Douglas-fir tussock moth (eggs, larvae and pupae).

A variety of arthropods and insects, such as spiders and ants also cause varying amounts of predation on tussock moth life stages. Insectivorous birds are a major source of mortality at low host densities. This complex of predators and parasites undoubtedly maintains the populations at low levels during non-outbreak years, and is what continues to keep the populations down once an intervening factor such as starvation, virus, or treatment has brought about collapse of an outbreak.

Douglas-fir tussock moth suppression projects have been conducted periodically throughout Idaho, Oregon, Washington, California, and British Columbia. From 1947 until 1974, DDT was the primary insecticide used. In almost all cases, treatment was applied during the decline phase of the outbreak cycle. It is doubtful that any benefit was gained from these treatments because most defoliation and tree mortality occurs during the first years of the outbreak (Wickman, 1978). If foliage protection is an objective for treatment, it must take place prior to significant defoliation.

Both B.t.k. and TM-BioControl have been tested experimentally and used operationally for a number of decades. As early as the 1960's projects using the virus were conducted in Nevada. Numerous additional studies were later conducted in Idaho, Oregon, British Columbia, and California (Stelzer and Neisess, 1978a; Tunnock, et. al., 1985). It was used operationally against outbreaks in New Mexico in 1978 and 1979. B.t.k. was field tested on various occasions in the early 1970's along with the NPV (Stelzer and Neisess, 1978b). Additionally, it was used operationally in 1989 on 84,000 acres on the Plumas NF. In 1991, 116,000 acres were treated with B.t.k. on the Wallowa-Whitman NF (Hofacker, et. al., 1992).

Between 1983 and 1993, evaluation and suppression projects using B.t.k. were conducted for western spruce budworm suppression throughout Oregon and Washington, primarily east of the Cascades. Since Douglas-fir tussock moth and western spruce budworm both use the same host species, Douglas-fir and true fir, it is very possible that many of the areas being considered for protection from Douglas-fir tussock moth have been treated at least once, and in some cases twice with B.t.k. in the past 15 years. Although the target insect in these projects was western spruce budworm, most certainly, any Douglas-fir tussock moth in the project areas was also exposed to the B.t.k. applications.

Effectiveness of Treatment

It is not the intent of the proposed treatment to attempt to control the tussock moth throughout the entire outbreak area. The primary project objective is to provide foliage protection and prevent tree mortality in specific Areas of Concern. Because tussock moth populations build up rapidly, cause significant defoliation in a short period of time, and then quickly collapse, the window for achieving this desired protection is very narrow, and the need to provide foliage protection is limited to one or two years. To prevent damage, populations need to be detected and controlled before tree defoliation occurs.

The insecticides are both biological. B.t.k. causes larvae to cease feeding in a day or two of ingestion. Larvae may continue to feed for slightly longer after ingesting the NPV, and the contagion effect of the virus spreading through the population may take several weeks. As a result, about 15 – 25% defoliation can be expected the year of treatment. In studies testing treatment on very young larvae in British Columbia, there was better tree recovery and significantly less tree mortality in treated versus untreated areas.

Both insecticides appear equally effective in bringing the populations down for the year or two prior to the widespread population collapse. Treatment with either B.t.k. or TM-BioControl prior to peak defoliation would achieve the project objective of protecting trees in the Areas of Concern until there was a natural collapse of the population. Some defoliation would still occur in treated areas. However, tree recovery and the prevention of subsequent tree mortality would achieve the short-term objective of maintaining the current condition of those sites during the current outbreak.

Resurgence or Reinvasion Following Treatment

Concern regarding the effectiveness of treatment is based primarily on the possibility that high insect populations would return one or two years following treatment. Experience with western spruce budworm treatment projects show that large scale projects, for the most part, do not provide more than 1-2 years of foliage protection (Sheehan, 1996a).

In the past, most operational DFTM projects were conducted during the decline phase of the outbreak cycle of the DFTM. The virus had already established an epizootic and populations were collapsing naturally. Resurgence of the outbreak would not have occurred regardless of treatment, because natural factors had already come into play. However, examples where treatment did

take place earlier in the outbreak cycle showed that the lowered prevalence of NPV in the treated plots did not result in recovery of the population to outbreak size (Thompson, 1978; Shepherd, et. al., 1984). No resurgence of a tussock moth population after treatment has ever been recorded.

The rapidity at which the natural virus can spread throughout the population prevents opportunity for DFTM populations to rebound. Once populations return to low levels, natural parasites and predators exert a significant influence on the later stages of decline and help to maintain endemic DFTM populations (Mason, et. al., 1983; Torgersen, pers. comm.).

Since the female Douglas-fir tussock moth does not fly, dispersion is limited to movement of early instar larvae by the wind. However, these larvae do not disperse in high enough numbers to create a new outbreak center before the outbreak collapses (Wickman, et. al., 1973). Therefore, insects do not reinvade treated areas from adjacent untreated areas.

Effects on Natural Control, Predators and Parasites

Disruptions of non-target organism populations are of concern when evaluating any alternative control method. The parasite and predator complexes of tussock moth are extremely efficient in locating and maintaining the DFTM populations at low levels. Although DFTM populations experience a rapid build-up and then total collapse in a short period, their parasites are unable to respond as quickly. Rather, they are most effective in maintaining low numbers of DFTM for long periods between outbreaks and in the collapse phase. The parasites respond somewhat to the increased host densities, taking advantage of the reduced host numbers brought about by the virus (Torgersen, personal communication). Treatment with TM-BioControl would not affect natural parasites or predators.

Little work has been done on the effects of B.t.k. on the DFTM parasites and predators. Parasites that would be most likely to be affected by an insecticide application would be those that infect the larval stage. Studies of effects of B.t.k. on parasites of western spruce budworm and gypsy moth report either alteration in abundance of parasites (i.e. there increases in some parasites and decreases in others, or there was no significant effect on the overall parasite complex. The primary parasites and predators of the tussock moth are the egg parasite, *Telenomus californicus*, and avian predators. It is unlikely that treatments with either B.t.k. or TM-BioControl would affect these.

As the virus epizootic runs its course, the infected later instar larvae serve as the primary means for returning the NPV back into the soil in the area. Early instar larvae that die from virus infection remain stuck to the foliage, where the NPV can readily infect other larvae. The greatest effect of applied control, whether with the virus or other insecticides, is to reduce the tussock moth populations so much that the NPV epizootic develops much more slowly or is prevented (Thompson, 1978). This results in reduced amount of virus in the forest ecosystem. Whether this reduction is significant, is not known. Treatments may cause a reduction in the virus in a localized area; but these impacts may not be comparable to those reductions caused by other disturbance factors. Adjacent untreated areas would serve as a reservoir for initiating future virus epizootics, and treatment would not eliminate the virus from the forest system.

Long-Term Resistance of the Insect to Insecticides

TM-BioControl: This insecticide is made of the natural virus of the tussock moth. Complete resistance of tussock moth to the virus has not been found, either in extensive laboratory rearing or in field populations. It has been proposed that resistance to an epizootic in an insect population is not easily established. By the time an epizootic has run its course, the surviving insects have usually completed their metamorphosis, migrated, or died from other causes, and a new, non-immune population has arisen (Steinhaus, cited in Thompson, 1978). Treatment using TM-BioControl would introduce the virus into the insect population 1-2 years earlier than it would naturally occur. Any resistance or natural selection for resistance against this virus would occur in response to the natural virus, regardless of treatment.

B.t.k.: There is a question regarding the potential build up of resistance in a population through repeated exposure to an insecticide. Douglas-fir tussock moth, in some of the proposed protection areas would have been exposed to one, and possibly two previous treatments with B.t.k. in the last 15 years. Resistance is developed by genetic selection against susceptible individuals in a population. Studies, under field and laboratory conditions, have shown that the diamondback moth, and other agricultural insects, such as the Indian-meal moth and tobacco budworm, and other moths can develop significant resistance through repeated exposure to B.t.k. (Tabashnik, et. al., 1990; Tabashnik, et. al., 1991; Tabashnik, 1994. The tests with diamondback moth did show that the resistance was recessive (Tabashnik, et. al., 1992). Variability in resistance of gypsy moth suggested the potential for resistance development through natural selection (Rossiter, et. al., 1990).

It is very unlikely that resistance to B.t.k. would build up in the tussock moth populations. B.t.k. has little direct effect on the natural enemies; development of those individuals that do not receive a lethal dose of B.t.k. is extended, thereby allowing them more exposure to natural parasites and subsequently being removed from the population. Forest insect populations may be exposed to a B.t.k. treatment once every 7 or 8 years, or even longer, on an average. Infrequent applications are not conducive to development of resistance. Genetic mixing with untreated populations during intervening years would result in any expression of resistance remaining in the background. Refuges of untreated areas, or areas treated with TM-

BioControl would allow genetic variability in the populations.

No Action Alternative

No treatment would be done under this alternative. Outbreaks would be allowed to continue under natural conditions. Treatment effectiveness, resurgence and reinvasion, and impacts on predators and parasites would not be an issue. The highest amounts of natural virus would return the forest ecosystem to normal levels under this alternative. Development of resistance to the virus, if it did occur, would be natural. There would be no opportunity for developing resistance to B.t.k., and it would continue to increase the amount of time since the last exposure of the insects to this insecticide.

Proposed Action

This alternative would protect selected Areas of Concern. All other infested areas would remain unprotected. Use of B.t.k. or TM-BioControl would be effective in reducing those populations in the treated areas and providing foliage protection and preventing tree mortality for the duration of the outbreak. Because of the short outbreak cycle and the fact that the female does not fly, there would be no opportunity for reinvasion into the treated area. There would be no impact on predators and parasites. Treatment may result in less virus being returned to the ecosystem in the treated areas, however it would still be present in untreated areas and the overall ecosystem. Resistance to TM-BioControl is not likely, or if it occurs it would be no different than would occur under natural conditions. Resistance to B.t.k. is not likely because of extended periods of time between exposure to B.t.k. and since there would be refuges of untreated insects in adjacent areas, and areas throughout the forests that would allow for genetic mixing.

Expanded Protection Alternative

In this alternative, the selected Areas of Concern plus additional areas with 60-100% host type would be protected. As with the Proposed Action, treatment with either TM-BioControl or B.t.k. would be effective in reducing populations in treated areas and providing foliage protection and preventing tree mortality for the duration of the outbreak. Because of the short outbreak cycle and the fact that the female does not fly, there would be not opportunity for reinvasion into the treated area. There would be no impact on predators and parasites. The natural virus exists in the soil for decades between outbreaks and most virus is returned to the soil through the larger infected larvae. During treatment with either B.t.k. or TM-BioControl, most larvae that die would be the younger larvae, and less virus would be returned to the ecosystem. More areas and acres would be treated in this alternative, so overall; there would be fewer viruses returned to the soil in the treated areas. Long-term impact of localized reductions in virus in the forest ecosystem is unknown. Untreated areas (20 – 60% host) would allow development and return of virus to the forest floor. It would still be present in the overall ecosystem, but in lesser amounts than with the Proposed Action. Resistance to TM-BioControl is not likely, or if it occurs it would be no different than would occur under untreated conditions. More acres would be treated with B.t.k., however, resistance to B.t.k. is not likely because of extended periods of time between exposure to B.t.k., and because there would still be refuges of untreated insects that would allow for genetic mixing.

TM-BioControl Only Alternative

This alternative would protect selected Areas of Concern with TM-BioControl only. All other infested areas would remain unprotected. It would be effective in reducing those populations in the treated areas and providing foliage protection and preventing tree mortality. Since the outbreak cycle is very short, only one or two years of foliage protection is required. Because of the short outbreak cycle and the fact that the female does not fly, there would be not opportunity for reinvasion into the treated area. There would be no impact on predators and parasites. The natural virus exists in the soil for decades between outbreaks and most virus is returned to the soil through the larger infected larvae. Treatment of younger larvae could result in less virus in the ecosystem. Long-term impact of localized reductions in virus in the forest ecosystem is unknown, however, untreated areas throughout the forests that would allow development and return of virus to the forest floor, it would be present in the overall ecosystem. Resistance to TM-BioControl is not likely, or if it occurs it would be no different than would occur under untreated conditions.

Table IV-7: Summary of Treatment on Douglas-fir Tussock Moth

	No Action Alt.	Proposed Action	Exp. Prot. Alt.	TM-B Only Alt.
Treatment effectiveness	None	High	High	High
Chance of resurgence or reinvasion	None	None	None	None
Impact on predators/parasites	None	None	None	None
Impact on natural virus	None	Unknown	Unknown	Unknown
Resistance to virus	None	None	None	None
Resistance to B.t.k.	None	None	Very Low	None

LEPIDOPTERA: NON-TARGET

The effects of Douglas-fir tussock moth on other Lepidoptera have not been studied. Competition for food probably exists. Defoliation and tree mortality from DFTM could serve to create Forest openings that would allow more shrubs, forbs, and grasses to grow. Since these plants harbor a significant portion of all Lepidopteran species, DFTM openings could improve overall habitat for other moths and butterflies (Hammond and Miller, 1998).

Effects of B.t.k. on other Moths & Butterflies

B.t.k. is a bacterium-based insecticide that has minimal effects on most terrestrial non-target species. For these species, the effect of B.t.k. is indirect, if present at all.

However, B.t.k. does affect many Lepidoptera species – (moths and butterflies). Given its broad range of efficacy, there can be little question that native species would be affected in a protected area. The magnitude of these effects depends on factors such as the number of applications, dosage, weather conditions, and the size of the protection area (Wagner, et al, 1996).

B.t.k. must be ingested to cause mortality; insects must be in the larval (caterpillar) stage and actively feeding on foliage on which the insecticide has been deposited. B.t.k. has been used in research studies and operationally against Douglas-fir tussock moth. In 1989, 84,000 acres were protected on the Lassen and Plumas National Forests in California (USDA, 1990) and in 1991; 116,000 acres were protected on the Wallowa-Whitman National Forest (USDA, 1992). Effects on non-target Lepidoptera were not monitored on these projects. However, a number of projects using B.t.k. to suppress or eradicate other Forest insects (western spruce budworm, gypsy moth, Asian gypsy moth) were monitored to determine effects on non-targeted species. These studies are individually summarized in Appendix E.

Applications of B.t.k. have been demonstrated to cause a significant decrease in the number of larval and adult Lepidoptera the year of protection (Miller, 1990a; Miller, 1990b; Sample, et al, 1993; Peacock, et al, 1994; Sample, et al, 1995; Johnson, et al, 1995; Miller, 1995; Wagner, et al, 1996; Peacock, et al, 1998; Hall, et al, 1999). Impacts include a significant decrease in the richness and/or abundance during the year of protection. Recovery to pre-protection levels for most species occurred in one to two years following treatment (Miller, 1990a; Miller, 1990b; Rondenhouse and Holmes, 1992; Sample, et al, 1993; Peacock, et al, 1994; Sample, et al, 1995; Miller 1995; Wagner, et al, 1996). Butterfly species appear to be highly sensitive; sensitivity by moth species appears to be greatly variable (Johnson, et al, 1995; Peacock, et al, 1998). Sensitivity also varies with the age of the larvae and whether the susceptible stage of the larvae coincides with the time of exposure to B.t.k.

A significant decrease in larval populations following protection does not mean that all Lepidopteran larvae are eliminated from the site. Since there would be fewer larvae available, animals feeding on these caterpillars either would search longer or would switch to other food sources.

There is less consistency in the reported effects on adult moth populations between projects. Some report a significant decrease in adult moths the year of protection (Miller, 1995; Hall, et al, 1999); others found few differences in adult populations between protected and unprotected areas (Sample and others, 1995; Grimble, 1995).

Variations in the results of these studies can be somewhat explained by project objectives. Gypsy moth projects, especially eradication projects, involved 2-3 applications of B.t.k. over a period of several weeks. This results in a much longer exposure for non-target Lepidoptera to B.t.k. In addition, because gypsy moth is a diverse feeder, there are more vegetative hosts, resulting in the need to spray more acres. This diverse habitat is also where the highest numbers of non-target Lepidoptera occur. Western spruce budworm projects specifically target conifer hosts. Areas of non-host species were excluded from protection since they did not harbor the target insect. Thus, many of the areas where significant populations of non-target Lepidoptera are found were eliminated from protection.

The biology of DFTM lends itself to a number of protection options and flexibility that may not be available in other Forest insect control projects. The DFTM is a "fast-cycle" insect and the female moth does not fly. This allows protection of discreet, even small areas without concern of spread or re-infestation back into the protected area. Protection areas can be designed to minimize impacts on non-target Lepidoptera.

There are no known threatened and endangered Lepidoptera species in the areas being considered in this analysis. There are no Lepidoptera on the Regional Forester's Sensitive Species List in the analysis areas. The Mardon Skipper *(Polites mardon)* is a candidate for Federal listing and is on the Washington State Threatened, Endangered, and Sensitive Species list. It does not occur in the analysis areas. Sightings have also been recorded in Klamath County Oregon, which contains some Areas of

Concern and expanded host covered in this analysis. If a project is identified for the Winema NF, additional information on exact locations of the colonies would be obtained to determine if they are in a potential protection area. Other candidate species from Washington that have been sighted in the project area include the Juniper Hairstreak (Callophrys [Mitoura] ryneus), Silver-bordered Fritillary *(Boloria selene shepadri)*, Great Artic (*Oeneis nevadensis*), and Shephard's Parnassian *(Parnassius clodius shepardi*). Of these, the Great Arctic occurs in a life stage and a habitat likely to be affected by treatment. Oregon does not have any listed or candidate Lepidoptera. The Sierra Nevada Blue (*Agriades podarce*) is listed as rare or local. It has been found in Klamath County in subalpine meadows; it will be an adult at the time of treatment. Most other rare species in the analysis area do not occur in a susceptible life stage or in a potentially protected habitat. The Garita Skipperling *(Oarisma garita*), Yuma Skipper (*Ochlodes yuma*), American Copper *(Lycaena phlaes)*, and Peck's Skipper (*Polites peckius*) occur either in a susceptible life stage or in potentially protected habitat. It is likely that most butterflies in larval feeding stage in protection areas would be affected by B.t.k. It is not known if B.t.k. will cause local extirpation of these species. Most are globally secure over the rest of their range. Hall and others (1999) reported that during an Asian gypsy moth eradication project in North Carolina, there was little evidence to suggest that any species were extirpated from the site; several rare species either survived or re-colonized the area.

Finally, there are no Lepidopteran species introduced for noxious weed control in the project area. Officials from the State Department's of Agriculture have indicated that should larval populations of an introduced biological control be affected by this project, they could be easily reintroduced back into an area (LaGasa and Coombs, pers. comm.).

Effects of TM-BioControl on Moths & Butterflies

TM-BioControl is made from a virus specific to tussock moth. The virus is known to infect only Douglas-fir tussock moth, western tussock moth (*Orgyia cana*), rusty tussock moth (*O. antiqua*), and white-marked tussock moth (*O. leucostigma*). The western and rusty tussock moths occur in the same areas considered for protection from Douglas-fir tussock moths (Thompson, 1978). It is anticipated that populations of these other two species would be affected by TM-BioControl if they reside in the protection area. Impact would be limited to mortality the year of proposed protection. In a normal DFTM outbreak, the natural occurrence of the virus would be significantly higher the following year and would infect the other associated tussock moths in that area.

Effects on Lepidoptera in Wilderness:

The application of protection measures in areas outside of or adjacent to Wilderness should have no effect on Lepidoptera in Wilderness. The only effect on moths and butterflies in Wilderness would probably be due to drift of the agents into Wilderness. However, project operations can be designed to minimize the likelihood of drift. Mitigation measures could include protecting areas immediately adjacent to Wilderness with TM-BioControl only, by leaving unprotected buffers around Wilderness areas, and by timing applications so that air currents would move spray away from Wilderness rather than into it.

A more detailed discussion of the effects on non-target Lepidoptera is in the analysis file, available upon request.

NO ACTION ALTERNATIVE

Under this alternative, there would be no insecticide impacts to non-target Lepidoptera. Competition for food from DFTM could have a short-term effect on other Lepidoptera. This alternative could result in extensive defoliation and subsequent tree mortality over the outbreak area, which could create forest openings where shrubs and grasses would increase habitat for moths and butterflies.

PROPOSED ACTION

This alternative proposes protection with either B.t.k. or TM-BioControl. Some of the non-target Lepidoptera in protection areas would suffer decreases in populations for 1 – 2 years due to the use of B.t.k. Populations of these other species would recover to pre-protection levels in one to two years. To minimize impacts of B.t.k. on non-targets, the Forest Service proposes to use TM-BioControl only in forested areas where these species provide a critical food supply for other wildlife. These areas include streams, spotted owl nest sites, important wildlife habitat areas, and areas which may harbor unusual Lepidopteran species. Where possible, areas that have little or no host type, or meadows, and forest edges would be left unprotected as non-target refuges. These precautions are expected to minimize the potential impact to non-target Lepidoptera at the landscape level. Reductions in non-targets would be limited to the localized protected areas.

Neither B.t.k. nor TM-BioControl would affect Lepidoptera populations in any unprotected areas. Competition for food from DFTM could have a short-term effect on other Lepidoptera. Defoliation could create large Forest openings where shrubs and grasses would provide increased habitat for moths and butterflies.

EXPANDED PROTECTION ALTERNATIVE

Effects on non-target Lepidoptera would similar to the Proposed Action, except that more acres would be protected with B.t.k. This could cause more short-term impacts on non-target Lepidoptera populations. Overall, impacts would be minimized using precautionary options as stated in the Proposed Action.

Competition for food from DFTM might have a short-term effect on other Lepidoptera. Fewer acres would be defoliated by tussock moths. Fewer acres that would be converted into forest openings where shrubs and grasses would provide increased habitat for moths and butterflies.

TM-BioControl Only Alternative

This alternative proposes protection with TM-BioControl Only. There would be no affects on non-target Lepidoptera other than western and rusty tussock moth.

TM-BioControl would not affect Lepidoptera populations in any unprotected areas. In those areas, competition for food from DFTM could have a short-term effect on other Lepidoptera. Defoliation could create forest openings where shrubs and grasses would provide increased habitat for moths and butterflies.

Plants – Threatened & Endangered Species

The Endangered Species Act requires that actions of federal agencies do not jeopardize threatened or endangered plants or their critical habitats. Proposed plants are those that the US Fish and Wildlife Service has sufficient data to consider for listing but that have not yet been formally listed. For this analysis, the US Fish and Wildlife Service list of threatened and endangered plants in Oregon and Washington was used to determine the status of vascular plant species. Forest botanists were queried to determine whether any of these species were known or suspected to occur in areas that could be affected by project alternatives. The effects analysis included plant habitats in/adjacent to host type, meadows, and riparian areas. Only those plants that could be in potentially affected habitats are discussed in detail.

No Action Alternation

Wenatchee National Forest

Widespread defoliation could allow an increase in light intensities to reach the forest floor. This could have a beneficial effect on Ute Ladies Tresses *(Spiranthes diluvialis),* Wenatchee Mountain Checkermallow (*Sidalcea oregana, var. calva),* or Showy Stickseed (*Hackelia venusta*) if they are stressed by low light conditions. *There would be an overall positive effect of the No Action Alternative on plant habitat.*

Umatilla National Forest

There are no known threatened or endangered plants on the Forest. A proposed species, Spaulding's silene (*Silene spauldingii*), is mostly pollinated by bees. The species occurs mostly in meadows, possibly on the edges of Douglas-fir types. Defoliation leading to increased light intensity would have no effect. *The No Action Alternative would have no effect on Spaulding's silene habitat.*

Wallowa-Whitman National Forest

Some populations of Spaulding's silene occur along the edge of Douglas-fir host types. Defoliation leading to increased light intensity would have no effect. *The No Action Alternative would have no effect on Spaulding's silene habitat.*

Fremont National Forest

There are no known threatened, endangered, or proposed plants on the Forest. Possible habitat for Ute ladies tresses exists but the species has not been found. *The No Action Alternative would have no effect on plant habitat.*

All Other Forests

There are no known threatened, endangered, or proposed plants on the Colville, Okanogan, Malheur, Ochoco, or Winema National Forests.

Proposed Action

Wenatchee National Forest

Ute Ladies Tresses: This plant has not been found on the Forest. It is possible it could occur in riparian zones but most potential protection areas in this alternative are unlikely habitat for the plant. The known bumblebee pollinator would not be affected by B.t.k. or TM-BioControl. *The Proposed Action would not effect on Ute ladies tresses habitat.*

Wenatchee Mt. Checkermallow: This plant is primarily a wet meadow species. Use of B.t.k. or TM-BioControl would not affect known Hymenoptera pollinators. Use of B.t.k. could affect Lepidopteran pollinators. If the Proposed Action were implemented, treatment would be excluded from a buffer zone around the Camas Lands populations and areas between and around Blewitt Pass. The buffer would include potential plant corridors and surrounding areas. *With the buffer, the Proposed Action would have no effect on Wenatchee Mt. Checkermallow habitat.*

Showy Stickseed: This shade-intolerant species is unlikely to occur in closed canopy forest. Information on plant pollination is limited. If the plant is pollinated by Lepidoptera, use of B.t.k. could have a negative effect on these pollinators. If this alternative were implemented, treatment would be excluded from a buffer zone around known populations. *With this buffer, the Proposed Action would have no effect on* Showy Stickseed *habitat.*

Umatilla National Forest

There are no known threatened or endangered plants on the Forest. There would be no effect due to defoliation or on pollinators, for the reasons explained in the No Action Alternative. *The Proposed Action would have no effect on Spaulding's silene habitat.*

Wallowa-Whitman National Forest

Some populations of Spaulding's silene occur on the edge of Douglas-fir host types. A bumblebee, *Bombus fervidus*, is the primary pollinator; it is unlikely there are Lepidopteran pollinators essential for the species. Defoliation in unprotected areas would have no effect. If this alternative were implemented, treatment would be excluded from a buffer zone around known populations. *With this buffer, the Proposed Action would have no effect on Spaulding's silene habitat.*

FREMONT NATIONAL FOREST

There are no known threatened, endangered, or proposed plants on the Forest. Possible habitat for Ute ladies tresses exists but the species has not been found. *The Proposed Action would have no effect on plant habitat.*

ALL OTHER FORESTS

There are no known threatened, endangered, or proposed plants species on the Colville, Okanogan, Malheur, Ochoco, or Winema National Forests.

EXPANDED PROTECTION ALTERNATIVE

WENATCHEE NATIONAL FOREST

The effects of the Expanded Protection Alternative are identical to those of the Proposed Action - no effect on plant habitat with appropriate buffers.

UMATILLA NATIONAL FOREST

The effects of the Expanded Protection Alternative are identical to those of the Proposed Action - no effect on plant habitat.

WALLOWA-WHITMAN NATIONAL FOREST

The effects of the Expanded Protection Alternative are identical to those of the Proposed Action - no effect on plant habitat with appropriate buffers.

FREMONT NATIONAL FOREST

There are no known threatened, endangered, or proposed plants on the Forest. *This alternative would have no effect on plant habitat.*

ALL OTHER FORESTS

There are no known threatened, endangered, or proposed plants species on the Colville, Okanogan, Malheur, Ochoco, or Winema National Forests.

TM-BIOCONTROL ALTERNATIVE

WENATCHEE NATIONAL FOREST

The use of TM-BioControl would have no effect on known or potential Lepidopteran pollinators. *All other effects of this alternative would be the same as the Proposed Action - no effect on plant habitat.*

UMATILLA NATIONAL FOREST

The use of TM-BioControl would have no effect on known or potential Lepidopteran pollinators. *All other effects of this alternative would be the same as the Proposed Action - no effect on plant habitat.*

WALLOWA-WHITMAN NATIONAL FOREST

The use of TM-BioControl would have no effect on known or potential Lepidopteran pollinators. *All other effects of this alternative would be the same as the Proposed Action - no effect on plant habitat.*

FREMONT NATIONAL FOREST

The use of TM-BioControl would have no effect on known or potential Lepidopteran pollinators. *All other effects of this alternative would be the same as the Proposed Action - no effect on plant habitat.*

ALL OTHER FORESTS

There are no known threatened, endangered, or proposed plants species on the Colville, Okanogan, Malheur, Ochoco, or Winema National Forests.

PLANTS – SENSITIVE SPECIES

Sensitive plants are those species that could become eligible for listing as federally threatened or endangered in the future. Sensitive plants are designated by the Pacific Northwest Regional Forester. The National Forest Management Act requires the Forest Service to consider the impact of Proposed Actions on these species and to take actions to insure their viability is not jeopardized. For this analysis, Forest botanists were queried to determine which plants from the April 1999 US Forest Service Region 6 Sensitive Plant Species List might occupy potentially affected habitats. Documented or suspected species in/immediately adjacent to host type, meadows, riparian areas, and other habitats were considered.

NO ACTION ALTERNATIVE

COLVILLE NATIONAL FOREST

There are 35 sensitive species documented or suspected to occur on the Forest. Several *Botrychiums* have been found but most are in cedar types or wetlands. *Cypripedium parviflorum* occurs in Douglas-fir host types and could be negatively impacted by defoliation, due to reduced canopy closure. *The No Action Alternative would have no overall impact on these plant habitats.*

OKANOGAN NATIONAL FOREST

Defoliation is not expected to cause changes in shading or light intensity that would have an impact on sensitive species. *The No Action Alternative would have no impact on plant habitat.*

WENATCHEE NATIONAL FOREST

If large-scale defoliation occurred, there could be a slight beneficial impact on high light intensity species and a slight negative impact on shade tolerant species. *Overall, the No Action Alternative would have no impact on plant habitat.*

UMATILLA NATIONAL FOREST

If defoliation reduced canopy closure, there could be a negative impact on *Cypripedium fasiculatum.* The fleshy roots could also be damaged by fire, resulting from increased forest fuels. Botrychiums could benefit from canopy openings. There would be no impact on *Ranunculus populago, Bolandra oregana*. *There would probably be no overall impact on plant habitat from the No Action Alternative.*

WALLOWA-WHITMAN NATIONAL FOREST

If defoliation from a DFTM outbreak opened the forest canopy, there could be a beneficial impact on Botrychiums from increased light to the understory. *The impact of the No Action Alternative on plant habitat would be positive.*

MALHEUR NATIONAL FOREST

Increased light intensity from tussock moth defoliation could have a beneficial impact on *Luina serpentina* and possibly *Thelypodium ucosomum. The overall impact of the No Action Alternative on these plant habitats would be positive.*

OCHOCO NATIONAL FOREST

This alternative could have a beneficial impact on Botrychiums because of increased light to the understory. There would be impact to other sensitive plants. *The overall impact of the No Action Alternative on plant habitat would be positive.*

WINEMA NATIONAL FOREST

Defoliation would have no impact on Mount Mazama Collomia (*Collomia mazama)* because most populations are located above DFTM host type elevations. There could be a positive impact on blue-leaved penstemon (*Penstemon glaucinus*) if defoliation opened the forest canopy. *There would be no overall impact of the No Action Alternative on these plant habitats.*

FREMONT NATIONAL FOREST

Blue leaved penstemon could benefit from widespread defoliation. Green-tinged paintbrush (*Castilleja chlorotica)* occurs mostly in sagebrush communities and would be unaffected by defoliation. *The overall impact of the No Action Alterative on these plant habitats would be positive.*

PROPOSED ACTION

COLVILLE NATIONAL FOREST

Neither *Cypripedium parviflorum* nor several species of *Botrychium* are pollinated by Lepidoptera. In addition, *Botrychium* are found mostly in cedar types or wetlands and are unlikely to be in proposed protection areas. *As a result, the Proposed Action would have no impact on these plant habitats.*

OKANOGAN NATIONAL FOREST

There are no known sensitive plants in proposed protection areas. Additionally, since most of the Forest sensitive species are wind pollinated or pollinated by non-Lepidoptera insects, it is unlikely that there would be any impact on most species. The mountain dandelion, *Agoseris elata,* is known to have a Lepidoptera pollinator but resides in meadows outside proposed protection areas. There would be no impact from defoliation in unprotected areas. *The Proposed Action would have no overall impact on plant habitats.*

WENATCHEE NATIONAL FOREST

There is little information on pollinators of sensitive plant species on the Wenatchee Forest. Since approximately 25 sensitive plants are estimated to occur in DFTM host type, it is possible that some Lepidoptera pollinate these species and would be susceptible to B.t.k. Use of TM-BioControl would have no impact on pollinators or these plants. Defoliation in unprotected areas could have a beneficial impact on high light intensity species and a negative impact on shade tolerant species. *The Proposed Action could impact individuals but is not likely to cause a trend toward federal listing.*

UMATILLA NATIONAL FOREST

If protection maintains or increases canopy closure, there could be a beneficial impact on *Cypripedium fasiculatum* habitat. It is unlikely this plant is pollinated by Lepidoptera. Information is not available for other sensitive species. Most *Botrychiums* on this Forest occur in lodgepole pine types, non-host type for DFTM. In unprotected areas, defoliation could cause a negative impact on *Cypripedium fasiculatum* but would have no impact on *Ranunculus populago, Bolandra oregana,* or Botrychiums. *Overall, there would be no impact on plant habitats from the Proposed Action.*

WALLOWA-WHITMAN NATIONAL FOREST

There is little/no information on Lepidopteran pollinators on the 20 sensitive species in host type. Therefore, potential impacts of B.t.k. on these plants are uncertain. Defoliation of unprotected areas could have a beneficial impact on *Botrychiums*. *Overall, the Proposed Action would have no impact on plant habitats.*

MALHEUR NATIONAL FOREST

Since no Lepidoptera pollinators are known to be essential, the use of either B.t.k. or TM-BioControl is not expected to impact sensitive plant pollinators. In unprotected areas, defoliation could have a beneficial impact on *Luina serpentina* and possibly *Thelypodium ucosomum. There would be no overall impact on these plant habitats.*

OCHOCO NATIONAL FOREST

Since Lepidoptera pollinators are not known to be essential for pollination of sensitive plants on the Ochoco, there would likely be no impact to plants in protected areas. There would still be beneficial impacts to light sensitive species in unprotected areas. *Overall, the Proposed Action would have no impact on plant habitats.*

WINEMA NATIONAL FOREST

Approximately 25% of the known *Collomia mazama* population occurs in proposed protection areas. Pollinators are mostly bees; no Lepidopteran pollinators have been observed. Since *Collomia* is a long-lived species, it would probably not be impacted by short-term pollinator fluctuations.

Blue-leaved penstemon is a light limited species that tends to become scarce and stunted when canopy closures exceed 40%. Only eight, widely separated populations

have been found in the Pacific Northwest. Habitat for this species is managed so that known populations have sufficient canopy openings for what is believed to be an adequate number and diversity of plants to maintain viability. The clear winged sphinx moth, *Hemeris diffinis*, has been seen taking nectar from this plant and represents the most likely long range pollinator. B.t.k. could have a negative impact on the moth. TM-BioControl is unlikely to impact this insect and thus, would probably not impact the plant. Defoliation in unprotected areas could enhance habitat for this species. The Proposed Action could impact individuals but is not likely to cause a trend toward federal listing.

There would be no impact on any of the other sensitive species. *As a result, there would be no overall impact on plant habitats.*

FREMONT NATIONAL FOREST

Blue-leaved penstemon is also found on the Fremont Forest. Effects of the Proposed Action are described for the Winema Forest, above. Green-tinged paintbrush, (*Castilleja chlorotica)* also occurs, primarily in mountain sagebrush communities interspersed with white fir. Lepidoptera are not known pollinators of this species so use of either B.t.k. or TM-BioControl should have no impact on this species. The species is moderately shade tolerant. Where canopies exceed 70% closure, defoliation in unprotected areas could benefit the plant. *Overall, the Proposed Action would have no impact on plant habitats.*

EXPANDED PROTECTION ALTERNATIVE

COLVILLE NATIONAL FOREST

Thirty-five sensitive species are documented or suspected to occur on the Forest. Of these, *Cypripedium parviflorum* occurs in Douglas-fir host types and may occur in some campground areas. There could be a beneficial impact on *Cypripedium fasiculatum* habitat where protection maintains or increases canopy closure. It is unlikely this plant is pollinated by Lepidoptera. Several *Botrychiums* have also been found on the Forest but most are in cedar types or wetlands and are unlikely to be in proposed protection areas. These species are not pollinated by Lepidoptera. *The Expanded Protection Alterantive would not impact plant habitat.*

OKANOGAN NATIONAL FOREST

There are no known sensitive plants in proposed protection areas. Additionally, since most of the Forest sensitive species are wind pollinated or pollinated by non-Lepidoptera insects, it is unlikely that there would be any impact on most species. The mountain dandelion, *Agoseris elata*, is known to have a Lepidoptera pollinator but resides in meadows outside proposed protection areas. There would be no impact from defoliation in unprotected areas. *This alternative would have no overall impact on plant habitats.*

WENATCHEE NATIONAL FOREST

Prevention of large-scale defoliation would probably maintain existing shade conditions in the understory. This would be beneficial to shade tolerant or shade dependant species. Potential impacts on pollinators are likely to be more pronounced than in the Proposed Action because of greater application of B.t.k. There would be no impact from use of TM-BioControl. *The Expanded Protection Alternative could impact individuals but is not likely to cause a trend toward federal listing.*

UMATILLA NATIONAL FOREST

There could be a beneficial impact on *Cypripedium fasiculatum* habitat where protection maintains or increases canopy closure. It is unlikely this plant is pollinated by Lepidoptera. Information is unavailable for other sensitive species. Most *Botrychiums* on this Forest occur in lodgepole pine types, non-host type for DFTM. In unprotected areas, defoliation would have no impact on *Ranunculus populago, Bolandra oregana*, or Botrychiums. *Overall, there would be no impact on plant habitats from the Expanded Protection Alternative.*

WALLOWA-WHITMAN NATIONAL FOREST

Since there is little/no information on pollinators, widespread use of B.t.k. could impact sensitive plants. *Based on current information, the Expanded Protection Alternative would have no impact on plant habitats.*

MALHEUR NATIONAL FOREST

Impacts are the same as the Proposed Action – no impact.

OCHOCO NATIONAL FOREST

Impacts are the same as the Proposed Action – no impact.

WINEMA NATIONAL FOREST

Greater use if B.t.k. could have a more negative effect on blue-leaved penstemon pollinators. As discussed previously, there would be no impact in protected or unprotected areas on *Collomia mazama* or other sensitive species. *There would be no overall impact of the Expanded Protection Alternative on plant habitats.*

FREMONT NATIONAL FOREST

Greater use if B.t.k. could have a more negative effect on blue-leaved penstemon pollinators. There would be no impact in protected or unprotected areas on other sensitive species. *The Expanded Protection Alternative would have no impact of on plant habitats.*

TM-BIOCONTROL ALTERNATIVE

COLVILLE NATIONAL FOREST

Impacts are the same as the Proposed Action – *no impact*.

OKANOGAN NATIONAL FOREST

Impacts are the same as the Proposed Action – *no impact*.

WENATCHEE NATIONAL FOREST

Use of TM-BioControl would have no impact on pollinators or plants. Defoliation in unprotected areas

could have a beneficial impact on high light intensity species. *This alternative would have no impact on plant habitats.*

UMATILLA NATIONAL FOREST

Impacts are the same as the Proposed Action – *no impact*.

WALLOWA-WHITMAN NATIONAL FOREST

Use of TM-BioControl only is unlikely to impact pollinators of proposed, threatened, or endangered species on the Wallowa-Whitman. *There would be no impact on plant habitats from this alternative.*

MALHEUR NATIONAL FOREST

Impacts are the same as the Proposed Action – *no impact*.

OCHOCO NATIONAL FOREST

TM-BioControl is unlikely to impact Lepidopteran pollinators of sensitive plant species on the Ochoco. *There would be no impact on plant habitats from this alternative.*

WINEMA NATIONAL FOREST

TM-BioControl is unlikely to impact Lepidopteran pollinators of sensitive plant species. *There would be no impact on plant habitats from this alternative.*

FREMONT NATIONAL FOREST

TM-BioControl is unlikely to impact Lepidopteran pollinators of sensitive plant species. *There would be no impact on plant habitats from this alternative.*

PLANTS – OTHER SPECIES

NO ACTION ALTERNATIVE

OKANOGAN & WENATCHEE NATIONAL FORESTS

Candy stick *(Allotropa virgata)* is a shade dependent species that lives (probably as a saprophyte) in the understory of Douglas-fir and true fir types. Extensive tree mortality could increase light intensity, negatively affecting this plant. Most *Botrychiums* on this Forest occur in non-host type. *The overall effect of the No Action Alternative would be negative.*

WINEMA NATIONAL FOREST

Cypripedium montanum and various fungi could be negatively impacted by extensive defoliation that resulted in increased light levels to the understory. The No Action Alternative would have a negative effect on plant habitats.

ALL OTHER FORESTS

There are no "Survey and Manage" plant species or other species of concern on the Colville, Umatilla, Wallowa-Whitman, Malheur, Ochoco, or Fremont National Forests.

PROPOSED ACTION

OKANOGAN & WENATCHEE NATIONAL FORESTS

It is doubtful that there are any Lepidopteran pollinators of *Allotropa virgata*. *Botrychiums* could benefit from canopy openings. Biotrophic fungi that require a living host could be affected by extensive tree mortality. The fungus *Bridgeporus nobilissimus* occurs in the noble fir zone but out of proposed protection areas. Survey and Manage lichens and most bryophytes are not in proposed protection zones. None of these species has Lepidopteran spore transmittal agents *so there would be no effect from use of either B.t.k. or TM-BioControl.*

WINEMA NATIONAL FOREST

Several survey and manage fungi species occur in proposed protection areas, specifically *Ramaria rubravanescens* which is found near Mares Egg Springs. Potential effects from changes in overstory closure are unknown. *Polyozelus multiplex, Nevadogastrum nubigenum, Ptelidium californica,* and *Plectania milleri* all occur in proposed protection areas sites. There are no known Lepidopteran spore transmittal agents. Implementation of the Proposed Action would maintain existing conditions. *There would be no effect from this action.*

ALL OTHER FORESTS

There are no "Survey and Manage" plant species or other species of concern on the Colville, Umatilla, Wallowa-Whitman, Malheur, Ochoco, or Fremont National Forests.

EXPANDED PROTECTION ALTERNATIVE

OKANOGAN & WENATCHEE NATIONAL FORESTS

Effects are the same as the Proposed Action – *no effects*.

WINEMA NATIONAL FOREST

Effects are the same as the Proposed Action – *no effects*.

ALL OTHER FORESTS

There are no "Survey and Manage" plant species or other species of concern on the Colville, Umatilla, Wallowa-Whitman, Malheur, Ochoco, or Fremont National Forests.

TM-BIOCONTROL ALTERNATIVE

OKANOGAN & WENATCHEE NATIONAL FORESTS

Effects are the same as the Proposed Action – *no effects*.

WINEMA NATIONAL FOREST

Effects are the same as the Proposed Action – *no effects*.

ALL OTHER FORESTS

There are no "Survey and Manage" plant species or other species of concern on the Colville, Umatilla, Wallowa-Whitman, Malheur, Ochoco, or Fremont National Forests.

HUMAN ENVIRONMENT: HEALTH

An in-depth risk assessment was done for B.t.k. in the *1995 Programmatic Gypsy Moth Environmental Impact Statement*; much of that information is incorporated by reference in this analysis. An in-depth risk assessment was also done for TM-BioControl (SERA, 1999); that information is also used in this analysis. The *Gypsy Moth EIS* also includes an analysis of Gypchek, which is the gypsy moth nucleopolyhedrosis virus equivalent to TM-BioControl. Some of the analysis for Gypchek in the *Gypsy Moth EIS* is inferred for TM-BioControl. Since gypsy moth (*Lymantria dispar L.*) is closely related to Douglas-fir tussock moth, some of the impacts from gypsy moth were inferred in the analysis of potential impacts from Douglas-fir tussock moth. Please see Appendix H for a more detailed discussion of the Human Health analysis.

The risk assessments used in this analysis considered the potential adverse human health effects from exposure to Douglas-fir tussock moth, B.t.k., and TM-BioControl. It was found that all cause the same general types of effects: skin, eye, or respiratory tract irritations. These effects are not life threatening or debilitating, and are reversible. Under routine conditions of exposure, the only agent likely to cause a substantial number of adverse health effects is the Douglas-fir tussock moth. Under extreme conditions, the use of B.t.k. could be associated with some irritant effects in some members of the public.

NO ACTION

ALL FORESTS

Human contact with hairs of Douglas-fir tussock moth larvae can cause an allergic reaction called "Tussockosis". Symptoms include skin, eye, and respiratory tract irritations and may require medical attention. People who work in the woods tend to have significant reactions; even mill workers handling forest products can develop Tussockosis. People who are sensitive or allergic to other insects tend to be more sensitive to DFTM (Perlman, et. al., 1976). Many people also find the overwhelming number of tussock moth larvae annoying. During an outbreak, there can be as many as 300,000 larvae/acre (SERA, 1999). This estimate is based on populations that are considerably lower than those in the 1972 – 1973 outbreak were. In a 1998 outbreak in a National Park, people were greatly disturbed by the presence of millions of larvae feeding on trees and raining fecal material onto them and their property (USDI, 1999).

As the density of the caterpillar population in an area increases, the risk of exposure to the insect also increases. For this analysis, those most likely to be exposed to DFTM would work, visit, or recreate in an infested area. The risk of human exposure is associated with the probability of coming in contact with larvae, cocoons, or eggs masses of the Douglas-fir tussock moth. For most people, there is a 41-83% chance of developing a skin rash after confirmed contact (Perlman, et al, 1976). Young children appear to exhibit more reactions than adults do, probably because they are more sensitive or because they spend more time outdoors.

Experience has shown that people who work in tussock moth-infested areas are affected more than are recreational visitors, especially in regard to allergic reactions. One study documenting the effects of a severe outbreak of the 1973 Douglas-fir tussock moth in Oregon and Washington observed that "occupational groups, including lumber mill workers, Forestry workers, and loggers experienced allergic response rates of 41, 44, and 83 percent, respectively, compared with a response rate of 22 percent in a group of presumably unexposed workers (Perlman et al. 1976: Press et al. 1977 in SERA 1999)." There were also reports that the garbage collectors suffered skin irritation from contacting the poisonous hairs of the caterpillar. The most severe exposures for loggers were characterized as "almost a rain of toxic and allergenic fallout (SERA 1999)." Many loggers with no history of allergies complained of skin rashes or welts, suggesting that the insect parts may contain both primary irritants as well as allergenic materials. Major reported effects included irritation to the skin, eyes, and respiratory tract (SERA 1999). A National Park study found that in a 1998 outbreak, about 30 to 40 Kings Canyon National Park Service and concession employees suffered symptoms of Tussockosis; five filed workmen compensation claims for treatment by a physician. The study notes, "One individual became so sensitized to the allergen that merely driving through the outbreak area produced symptoms including itchy, watery eyes and shortness of breath (USDI 1999)." The Park Service felt that Tussockosis could be such a problem with their field employees that visitor areas might be closed because of the risk posed to Park Service employees staffing those areas (USDI 1999).

PROPOSED ACTION

ALL FORESTS

Effects of B.t.k. on People

The most common effects from exposure to B.t.k. are eye, skin, and respiratory tract irritation. Under usual conditions, B.t.k. does not pose a substantial risk to workers or the public. As with any preparation containing microorganisms, concerns include pathogenicity, persistence of the microorganism in the human body, genetic stability of the microorganism in the environment, and ability of the microbial agent to interact with other microorganisms. B.t.k. formulas are complex and may have toxic properties that are unrelated to the presence of B.t.k. It is unclear, however, if effects on humans are caused by the microorganism or by the other compounds (inert ingredients) in the formula. The EPA concluded B.t.k. is not a human pathogen; the British Columbia

Ministry of Health concluded that B.t.k. is specific to Lepidopteran caterpillars and does not pose a threat to humans.

The composition of inert ingredients in the commercial formulations of B.t.k. and their significance to public health is a matter of concern. Although the identities and quantities of inert ingredients are proprietary information, all are generally recognized as safe by EPA. Additives in the preparation known commercially as Foray 48B are approved for use in foods in both the U.S. and Canada. All inert compounds have been reviewed by EPA and various agencies in Canada (USDA, 1995). In addition, the Oregon Department of Human Resources reviewed Foray 48B and determined that exposure to Foray 48B would be unlikely to pose a public health risk (Flemming, 1993, cited in USDA, 1995). In preparation of the risk assessment for the Gypsy Moth EIS, EPA files on product chemistry were reviewed for all B.t.k. formulations.

The aerial and ground methods of spraying B.t.k. suggest that the likeliest routes of exposure by the public are through the mouth, skin, and respiratory tract. Accidental exposures through the eyes could occur in workers. During ground spraying, workers could be exposed to high levels of B.t.k. Variables that influence actual exposure rates are concentration of B.t.k., specific application methods, duration of exposure, and the type of job. For workers, skin contact with B.t.k. suspended in air is the primary exposure concern. Epidemiological studies have not detected any adverse effects to the exposed people. In addition, a surveillance program by family physicians noted no substantial difference in the reports of symptoms that might be associated with B.t.k. exposure in versus outside the spray area (cited in USDA, 1995; Capital Health Region Office, 1999). Based on these studies and the long history of use, no hazard has been identified for members of the public exposed to B.t.k.

Little information is available on groups with special sensitivities, such as allergies or chemical sensitivities, to B.t.k. In British Columbia, only a weak relationship was noted in the incidence of irritant effects between ground workers with and without a history of asthma, seasonal allergies, or eczema (Cook, 1994, cited in USDA, 1995). In a more detailed study, asthmatic children both in and out of the spray zone were monitored before, during, and after aerial applications of B.t.k. Children in the spray zone did not have more symptoms than those outside the spray zone (Capital Health Region Office, 1999). Finally, workers or members of the public who are exposed to B.t.k. would also be exposed to the Douglas-fir tussock moth.

Studies of possible cumulative effects have tried to consider both residual exposure to B.t.k. formulas after a single application and the effects of multiple applications in a single season and over several years. In the Douglas-fir tussock moth project, the only group likely to be subject to successive years of exposure would be workers who happened to work on successive projects in different areas. In this respect, no cumulative effects from spray programs conducted over several years are anticipated.

Effects of TM-BioControl on People

Douglas-fir tussock moth virus occurs naturally and is responsible for the collapse of most DFTM outbreaks. TM-BioControl is a powdered formulation of the virus, developed and registered by the USDA Forest Service for control of Douglas-fir tussock moth. It is produced by the *in vivo* culture of infected DFTM larvae. Therefore, most (about 89%) of the formula consists of ground tussock moth caterpillar parts. The TM-BioControl powder is mixed with water, molasses, a sunscreen, and a sticking agent, and is applied at the rate of 1-2 gallons per acre. In some instances, TM-BioControl may be mixed with a premixed carrier called Carrier 038. All of the components of Carrier 038 are on the EPA list as Generally Recognized As Safe; all are exempt from residue tolerances under Chapter 40 of the Code of Federal Regulations, Section 180.1001. Most of the components are complex natural products and are not chemically defined.

TM-BioControl is known to cause skin, eye, and respiratory tract irritation in humans. Most of the available mammalian toxicity data on TM-BioControl was generated in the mid-1970s as part of the registration. The available data regarding the effects of exposure suggest that the irritant effects are probably due to the occurrence of insect parts in the TM-BioControl formulation.

During re-registration of TM-BioControl, the EPA determined that formal exposure assessments for the public and workers were not required because of the lack of any apparent systemic toxic effects and because the use of TM-BioControl would not substantially increase ambient levels of either the natural virus or insect larval parts. It appears the protection of a severe Douglas-fir tussock moth infestation with TM-BioControl would increase the environmental levels of the virus by less than 3%. In addition, the use of TM-BioControl to prevent a severe infestation would reduce eventual exposures to both the virus and insect larvae. For these reasons, use of TM-BioControl may be beneficial rather than potentially detrimental to members of the public.

There is no basis for asserting that workers are subject to any risk of systemic adverse effects from the use of TM-BioControl. Nonetheless, workers involved in the mixing of TM-BioControl are required to take reasonable measures and use personal protective equipment to limit the potential for introducing the formulation into their eyes. If members of the public were exposed to a spray of TM-BioControl, the primary concern would be the insect parts in the formulation. There is a low apparent risk associated with just one application of TM-BioControl. Because of the fast acting nature of the virus, area would not be protected more than once, either during the same year or in successive years; repeated exposure is not expected. Individuals with pre-existing allergies may be at greater risk of effects from TM-BioControl.

Expanded Protection Alternative

All Forests

Same effects for B.t.k. & TM-BioControl as in the Proposed Action, however, there would be more exposure to humans.

TM-BioControl Only Alternative

All Forests

Same effects to humans as the Proposed Action for TM-BioControl. No B.t.k. would be used.

Human Environment: Municipal Watersheds

No Action

All Forests

Heavy defoliation and subsequent mortality could occur in all municipal watersheds. Insect activity and defoliation could cause users to raise water quality and quantity concerns. However, the actual effect on these watersheds is expected to be minor and on a scale too small to measure by conventional means. During heavy defoliation, water quality may be affected by direct contamination with frass (insect fecal matter). As an example, during a gypsy moth outbreak while caterpillars were feeding, levels of fecal streptococci and fecal coliform increased significantly. No adverse effects were reported, however. Similar short-term increases in these levels could be expected with DFTM defoliation as well.

Increased fuel loads from defoliation and additional tree mortality from bark beetles will increase the risk for subsequent high intensity fires, which could affect water quality and sedimentation in streams. There is a significant amount of host type in each watershed (from 47 to 61 percent of the National Forest land area in each watershed), increasing the probability of effect from an outbreak The likelihood of fire occurrence in the watersheds in any given year immediately following the defoliation may not be high, but the consequences of a fire event in the first several years after an outbreak would be significant. The cumulative probability of a fire event during the several decade period following an outbreak is high, and fire severity would be high, thus the consequences of a fire would also be significant. Secondary mortality from bark beetles is likely, particularly in the Tiger Canyon and the Mill Creek watersheds where there are existing Douglas-fir beetle outbreaks.

Proposed Action

All Forests

This alternative would protect municipal watersheds from defoliation. There would be no change in sediment, nitrogen, or peak flows regimes because of a tussock moth outbreak. This action would reduce the risk of potential fuel buildup that would result from an outbreak, and the subsequent possibility of sedimentation and peak flows that would result from high intensity fires.

Expanded Protection Alternative

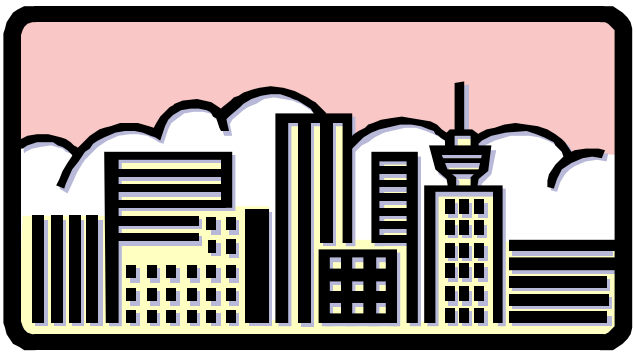
All Forests

This alternative would protect municipal watersheds from defoliation. There would be no change in sediment, nitrogen, or peak flows regimes from a tussock moth outbreak. This action would reduce the risk of potential fuel buildup that would result from an outbreak, and the subsequent possibility of sedimentation and peak flows that would result from high intensity fires.

TM-BioControl Only Alternative

All Forests

This alternative would protect municipal watersheds from defoliation. There would be no change in sediment, nitrogen, or peak flows regimes because of a tussock moth outbreak. This action would reduce the risk of potential fuel buildup that would result from an outbreak, and the subsequent possibility of sedimentation and peak flows that would result from high intensity fires.



Human Environment: Recreation, Residential & Administrative Sites

No Action

All Forests

The effect of tussock moth damage on high-use recreation sites would likely be more severe than in areas where recreation is dispersed over larger areas. Recreation sites tend to have high levels of investment in infrastructure and services, leading to proportionally high losses in recreation value from the physical damage and nuisance effects of a tussock moth outbreak. Recreation sites include campgrounds, summer home areas, organization camps, visitor centers, viewpoints, and other places of concentrated recreation use. Campers are often the first to complain about the presence of the tussock moth. Larvae and their fecal pellets fall on picnic tables, cars, and tents, causing considerable annoyance to campers (Wickman & Renton 1975). Sites that are especially unique, popular or have high capacity may suffer the most loss because comparable substitute sites are not available. A good

example of this situation is a National Park. Nuisance effects from a 1998 Douglas-fir tussock moth outbreak experienced at Sequoia/Kings Canyon National Park in California include: reduced camper nights and revenue; reduced overnight stays in lodging businesses; reduced number and duration of day-use visitors; loss of revenue for concessionaires because of lower day use; and revenue losses to private businesses that serve receptionists. The National Park Service found a decline of nearly 2,000 occupied overnight camping spaces for the period July 1 - September 10, 1999. Due to nuisance effects, the National Park Service found that concessions operators were granting refunds when requested by guests who considered the rooms in the lodge unsatisfactory because of the presence of caterpillars (USDI 1999). Saddle stock in the Park was also affected. A commercial stable operator closed four weeks early because of the problems encountered in dealing with the outbreak, resulting in an estimated $20,000 loss in gross revenues (USDI 1999). The Park Service believed that many camping parties had intended to spend more than one night in the area left early because of the highly visible effects of the larval population. Approximately 100 visitors requested medical assistance or advice because of skin rashes or other minor allergic reactions over the course of the summer, believed to be associated with Tussockosis. A few visitors requested a refund of camping fees after spending a night.

Costs associated with tree damage in recreation sites include the diminished recreation experience and the cost of removing and replacing lost trees. Studies show that larger trees and a variety of tree species are positively correlated with higher benefit levels. The presence of visible damage, dead, and dying trees, and smaller average tree size that can result from tussock moth damage has an impact on recreation (Rosenberger, 1997). The impact of insects feeding on trees in recreation sites needs to be evaluated by the loss of shade, screening, and esthetic qualities. Dead trees and tops from top-killed trees often need to be removed from recreation sites because they are hazardous. The costs of removing hazardous trees are in addition to the replacement costs associated with restoring vegetation in camp units (Wickman & Renton 1975). Because of the lost amenity values, neither the hazard removal cost nor the replacement cost may adequately represent the lost recreation benefits associated with damaged sites. For example, Sequoia and Kings Canyon National Parks, predicted "many trees would be lost in the campground and other development areas. Many of these would be large, old-growth trees, which would not be replaceable in our time (USDI 1999)." Generally, the loss of recreation benefits would accrue until replacement trees grow to sufficient size to mitigate the damage caused by the insects (Wickman and Renton 1975)."

Residential and administrative sites include offices, work centers, residences, summer homes, organization camps, resorts, and other places where people work and live in the boundaries of National Forest System lands. These sites are prone to similar types of health and nuisance problems from the tussock moth that afflict high use recreation sites, but to a greater degree, residential and administrative sites are generally permanent sites that cannot be reasonably avoided in favor of alternate locations during a tussock moth outbreak. If unable to temporarily relocate or suspend occupancy, people either suffer from exposure to the insect or absorb a substantial loss or inconvenience by staying away. The principal values at risk of health and nuisance effects include recreation benefits (organization camps, summer homes and resorts) and occupational safety (offices, work centers and other facilities or sites staffed by federal employees, contractors, and volunteers, and private sector workers).

Like recreation sites, residential and administrative sites are at risk of physical tree damage or death, including similar loses of the shade, screening, and esthetic benefits associated with trees. In addition, like recreation sites, there is a cost to remove and replace damaged or dead trees. There is obviously considerable overlap among recreation sites and administrative sites because people often live and work in the same areas that people recreate. In addition, like some recreation sites, these areas can have considerable investment in infrastructure. The overall value of the site can be diminished by the loss of trees, especially in the short term.

Proposed Action

All Forests

Residential and administrative sites would be protected from high populations of Douglas-fir tussock moth. All high-use recreation sites would also be protected. Application effectiveness is expected to be high. In most cases, all existing benefits from these Forest uses would continue.

Expanded Protection Alternative

All Forests

This alternative provides the same protection to residential and administrative sites as the Proposed Action and greater protection for forest workers because more sites could be protected. Records from previous outbreaks indicate many Forest workers suffer severe allergic reactions to tussock moth larvae. As the protection area grows, there is less risk that Forest workers would be exposed to the highly allergenic larvae. All high-use recreation sites would also be protected. In most cases, all existing benefits from these Forest uses would continue.

TM-BioControl Only Alternative

All Forests

Residential and administrative sites would be protected from high populations of Douglas-fir tussock moth. All high-use recreation sites would also be protected. Application effectiveness is expected to be high. In most cases, all existing benefits from these Forest uses would continue.

HUMAN ENVIRONMENT: SCENIC AREAS

NO ACTION

ALL FORESTS

Scenic views would not be protected with this alternative. The extent of damage would generally be proportional to the number of acres at risk, and eventually infested. Generally, the more intensively used and viewed a landscape is, the larger the levels of scenic benefits are at risk. Damage to foreground views would be greater than to background views because their relative closeness makes changes in vegetation more evident. In extreme cases, foreground views could be substantially harmed. However, previous damage patterns suggest that most effects would be minor and of short duration. Impacts on backdrop views are expected to be low.

PROPOSED ACTION

ALL FORESTS

This alternative would protect all foreground scenic Areas of Concern to prevent or minimize damage to these landscape views.

EXPANDED PROTECTION ALTERNATIVE

ALL FORESTS

In addition to foreground scenic views protected in the Proposed Action, this alternative would also protect middle and background views. However, since the overall impact of DFTM on backdrop scenic views is expected to be low, the gain from protecting these additional areas is also expected to be low.

TM-BIOCONTROL ONLY ALTERNATIVE

ALL FORESTS

This alternative would protect all foreground scenic Areas of Concern to prevent or minimize damage to these landscape views.

ISSUE 1: HUMAN HEALTH EFFECTS

NO ACTION ALTERNATIVE

In this alternative, individuals would not be exposed to the effects of B.t.k. or TM-BioControl. However, people recreating and working in infested areas would be exposed to the irritant effects of the Douglas-fir tussock moth. Based on previous data, approximately 25%-40% of the public and 41% to 75% of the workers would experience reactions.

PROPOSED ACTION

This alternative identifies protecting specific Areas of Concern. Some areas would be protected with TM-BioControl and some would be protected with B.t.k. Many of the proposed protection areas are remote. For the most part, the public would not be exposed to the biological control agents. Should individuals be in campgrounds or at administrative sites during direct aerial application, they could experience transient skin, eye, or respiratory tract irritations. Workers would have a higher level of exposure.

Because this alternative does not propose to protect all of the potentially infested areas, and because none of the adjacent state or private lands would be protected, most people would also be exposed to the effects of the Douglas-fir tussock moth. Based on previous data, approximately 25%-40% of the public and 41% to 75% of the workers would experience reactions.

EXPANDED PROTECTION ALTERNATIVE

This alternative proposes to protect Areas of Concern in mentioned in the Proposed Action plus more of the infested general Forest areas. The additional acres would probably be protected with B.t.k. As with the Proposed Action, many of the likely protection areas are remote. For the most part, the public would not be exposed to the protection. Because this alternative proposes to protect more, but not all of the potentially infested areas, and because none of the adjacent state or private lands would be protected, members of the public and workers in these areas would also be exposed to the effects of the Douglas-fir tussock moth in untreated acres.

TM-BIOCONTROL ONLY ALTERNATIVE

In this alternative, individuals would not be exposed to the effects of B.t.k. Exposure to TM-BioControl would be the same as in the Proposed Action. People recreating and working in infested areas would be exposed to the irritant effects of the Douglas-fir tussock moth. Based on previous data, approximately 25%-40% of the public and 41% to 75% of the workers would experience reactions.

ISSUE 2: PROTECTION OF TIMBER VALUES

The value of timber is a function of many factors: wood quality, market conditions, and logging costs. The focus here is on tree mortality as wood quality in dead trees changes over time, and market conditions and logging costs would vary depending on specific timing and location of timbers sales. For these reasons, no attempt to

estimate or analyze the stumpage value was made. However, wood quality and thus the value of the raw material would change by the tussock moth defoliation and by secondary bark beetle infestation with subsequent tree mortality.

Over time, the wood quality in the dead trees would deteriorate so that by the end of 3 to 8 years, the log loses its value as saw material. Total defoliation on all host type trees is not expected, but over the landscape, an estimate can be made of the proportion of host type that would be totally defoliated or partially defoliated. From that, it is possible to estimate mortality assuming no treatment is done to prevent an outbreak of the insect. Mortality estimates are based on the rules included in Appendix K.

No Action Alternative

No portion of the 2,670,000 acres of merchantable timber in host type would be protected.

Proposed Action and TM-BioControl Alternative

This alternative would protect some trees from defoliation. Areas of Concern include: 1) habitat for species listed through the Endangered Species Act, 2) investments such as seed orchards or developed campgrounds, or 3) areas where there are high concentrations of people such as administrative sites or campgrounds. About 2,139,000 acres of merchantable timber would not be protected. Any of the areas outside the Proposed Action or the TM-BioControl alternative areas that are in host type may see partial or complete defoliation.

Expanded Protection Alternative

This alternative would protect trees from defoliation in all areas in the Proposed Alternative plus remaining areas that contain over 60% host type (not including Wilderness). About 794,000 acres of merchantable timber would not be protected and essentially all that would be in 20-60% host type.

Table IV-8, below, shows a worst-case scenario of mortality by alternative in areas available for harvest. The mortality would occur in areas not being protected and that are available for harvest. These are just estimates, which take into account the risk of the Douglas-fir tussock moth outbreak across the landscape on National Forests in Eastern Washington and Oregon.

A more likely scenario is drawn from the experience of the outbreak during 1972 through 1973 (USDA FS, 1974). That outbreak caused damage on about 700,000 acres or about 16% to 17% of host type areas. Assuming the current expected outbreak takes a similar course and is evenly distributed over the landscape, there would be defoliation on areas available for timber harvest of about 100,000 MBF for the Proposed Action and TM-BioControl Only alternatives, probably less than 100 MBF for Alternative 2, and about 130,000 MBF for the no action alternative.

Mortality actually experienced during the tussock moth outbreak was approximately 588,000 MBF on National Forest lands during the years 1972-73 (USDA FS, 1974). Probably, most of the difference in volume from the 130,000 MBF estimated above is from the fact that it was calculated on all areas in the national Forests. The latter 130,000 MBF is estimated only on areas currently allocated for timber harvest. In addition, standards to enhance wildlife and fish habitat as well as other resources have decreased volume available on a per acre basis.

Table IV-8: Worst-case mortality, in thousand board feet

	No Action Alt.	Proposed Action & TM-BioControl Alt.	Expanded Protection Alt.
Colville	105,076	102,338	33
Okanogan	22,901	18,821	1
Wenatchee	48,380	13,838	2
Umatilla	250,995	200,809	7
W-W	264,582	209,836	20
Malheur	45,124	34,345	4
Ochoco	52,533	8,939	< 1
Winema	4,486	3,396	2
Fremont (Demming Crk. Only)	117	11	< 1
Total	**794,194**	**592,333**	**70**

ISSUE 3: EFFECTS ON NON-TARGET LEPIDOPTERA

Effects of Douglas-fir Tussock Moth on other Moths & Butterflies

Refer to the Lepidoptera section on page IV-42for a more complete discussion of non-target Lepidoptera. A brief summary of that discussion follows:

Since non-target Lepidopterans are affected by B.t.k., the populations of many species would decrease for 1 to 2 years. There are no threatened, endangered, or sensitive species in the project area. Five species proposed for listing are found in the project area: Mardon Skipper in Klamath County, OR and 4 species in Washington. Only the Great Arctic would be in a life stage that would cause it to be affected by B.t.k. It lives in coniferous forest openings and meadows, areas where the use of B.t.k. will be avoided, per the Mitigation Measures discussed in Chapter II.

NO ACTION ALTERNATIVE

Under this alternative, there would be no insecticide impacts to non-target Lepidoptera. Competition for food from DFTM could have a short-term effect on other Lepidoptera. This alternative could result in extensive defoliation and subsequent tree mortality over the outbreak area, which could create forest openings where shrubs and grasses would increase habitat for moths and butterflies.

PROPOSED ACTION

This alternative proposes protection with either B.t.k. or TM-BioControl. Some of the non-target Lepidoptera in protection areas would suffer decreases in populations for 1 – 2 years due to the use of B.t.k. To minimize impacts of B.t.k. on non-targets, the Forest Service would use TM-BioControl only in forested areas where these species provide a critical food supply for other wildlife. These areas include streams, spotted owl nest sites, important wildlife habitat areas, and areas that harbor unusual Lepidopteran species. Where possible, areas that have little or no host type, or meadows, and forest edges would be left unprotected as non-target refuges.

Neither B.t.k. nor TM-BioControl would affect Lepidoptera populations in any unprotected areas. Competition for food from DFTM could have a short-term effect on other Lepidoptera.

EXPANDED PROTECTION ALTERNATIVE

Effects on non-target Lepidoptera would similar to the Proposed Action, except that more acres would be protected with B.t.k. This could cause more short-term impacts on non-target Lepidoptera populations. Overall, impacts would be minimized using precautionary options as stated in the Proposed Action. Competition for food from DFTM might have a short-term effect on other Lepidoptera.

TM-BIOCONTROL ONLY ALTERNATIVE

This alternative proposes protection with TM-BioControl Only. There would be no affects on non-target Lepidoptera other than western and rusty tussock moth. TM-BioControl would not affect Lepidoptera populations in any unprotected areas.

ISSUE 4: MAINTAINING HEALTHY FORESTS

NO ACTION ALTERNATIVE

Stands would not be protected from tussock moth defoliation. Varying levels of defoliation and mortality would be expected. Stands with dense crown closure and high risk of outbreak are generally dry, overstocked sites with low vigor and high susceptibility to a variety of Forest pests and pathogens. The highest mortality and most pronounced changes in structure are expected in these stands.

Where substantial defoliation and mortality occurs, restoration efforts could be delayed or rescheduled in response to changes in stand structure and fuel load.

PROPOSED ACTION

High-risk protected stands would continue to experience declining vigor due to overstocking. Susceptibility to defoliating insects, bark beetles, and root diseases would remain high unless stocking control and species composition was changed through other means (Wickman et al. 1986). Protected stands at moderate risk would generally maintain current rates of growth and development.

In unprotected high and moderate risk stands, significant defoliation and mortality is expected. Bark beetles attracted to stressed trees could cause additional mortality (Wickman, 1963). Eventually, this could create sufficient openings to change stand conditions. Changes would be most evident in high risk stands where defoliation and subsequent mortality would be greatest. Little or no change in stand dynamics is expected in low risk stands.

In summary, implementation of this alternative would retain canopy cover on 236,000 acres of high-risk dry Forest where defoliation would result in damage to Areas of Concern. Retaining host type on these acres would be a short-term strategy until other Forest health restoration efforts could be implemented. Where substantial defoliation and mortality occurs, restoration efforts could be delayed or rescheduled in response to changes in stand structure and fuel load.

EXPANDED PROTECTION ALTERNATIVE

In addition to the areas protected in the Proposed Action, all 60-100% host type would be protected to prevent defoliation if an outbreak occurs. Dense host type Forests on dry sites would continue to experience declining vigor. Susceptibility to defoliating insects, bark beetles, and root diseases would remain high. Eventually, one of these disturbance agents or wildfire would remove most of the host type, reduce crown closure, and initiate stand regeneration (Wickman et al, 1986). Non-host species

such as ponderosa pine and larch would increase after the outbreak. Unless measures were taken to later reduce stocking of naturally regenerating firs, pines and larch would eventually be replaced, starting the tussock moth cycle over again.

TM-BIOCONTROL ONLY ALTERNATIVE

Effects would be the same as the Proposed Action.

ISSUE 5: FUEL BUILD-UP AND FIRE RISK

From a fire fuel standpoint, No Action would result in the highest fuel buildup over the next 15 years. The Proposed Action would protect about 13% of the acres expected to The Expanded Protection Alternative would protect 55% to 60%. The effects for the TM-BioControl Only alternative are the same as the Proposed Action. In all unprotected areas, Forest fuels will continue to accumulate, increasing the risk of ignition and catastrophic fire. The amount of protection is inversely proportional to the risk of fire in the next 15 years

ISSUE 6: EFFECTS OF SPRAYING ON FISH AND WILDLIFE

Field applications of B.t.k. and TM-BioControl would result in direct and indirect exposures to some non-target organisms. Exposure could result in absorption through cuticle or skin, ingestion, or inhalation. Potential effects on specific species were discussed previously. For information on threatened and endangered species, refer to pages IV-15 and IV-27. For effects on sensitive species, please refer to Table IV-6 on page IV-33 and the discussion that follows. For information on Survey and Manage Species, refer to page IV-35. For information on all other wildlife, refer to page IV-36.

Effects of B.t.k. on Fish and Wildlife

The U.S. Environmental Protection Agency (EPA) has concluded that toxicity and infectivity risks of B.t.k. to non-target avian, freshwater fish, freshwater aquatic invertebrates, arthropod predators/parasites, honey bees, annelids and mammalian wildlife is minimal to nonexistent at the label use rates of registered B.t.k. (EPA, 1998). Due to the relatively short half-life of B.t.k., the exposure and subsequent risk to non-target wildlife is limited to the time immediately after application (EPA, 1998). B.t.k. toxins degrade rapidly when exposed to sunlight. As a result, exposure to most above-ground non-target organisms is expected to be minimal.

Vertebrates are not susceptible to B.t.k. toxicity because the mode of action precludes any concern for dermal and inhalation routes (USDA, 1995). A wide range of studies has been conducted on test animals, using several routes of exposure. The results of these tests suggest the use of B.t.k. produces few, if any, negative effects. B.t.k. did not have acute toxicity in tests conducted on experimental birds, dogs, guinea pigs, mice, rats, and other animals. (Extension Toxicology Network 1988). Acute toxicity studies performed on laboratory rodents indicated that there are unlikely to be any adverse effects on wild mammals (EPA 1998).

B.t.k. is toxic to bees and earthworms but only at doses greater than expected in normal pesticide applications (USDA, 1995). Among the susceptible non-target insect populations, recovery takes place soon after cessation of pesticide use (EPA, 1998).

The lack of any documented fish kills, despite the use of B.t.k. in Canadian Forestry and agricultural control programs for nearly 20 years, has been advanced as an argument that B.t.k. does not kill fish (USDA ,1995). Field studies on B.t.k.-contaminated water found no observable effects on resident fish behavior or reproduction. No toxicity or pathogenicity was evident in bluegill or rainbow trout with B.t.k. (EPA ,1998). B.t.k. has also not been shown to bio-accumulate in fish (USDA, 1995). Field observations of brook trout, common white suckers, and small mouth bass did not reveal adverse effects one month after aerial application of B.t.k. (Extension Toxicology Network 1988). An extensive study published in 1990 by Environment Ontario detailed the results of a 10-year effort to examine the effects of B.t.k. on the aquatic environment. Much of the study examined anadromous and resident trout species and concluded that B.t.k. did not have a detrimental effect on reproduction, growth, or the general health of stream trout (Surgeoner & Farkas, 1990). No unreasonable risk to freshwater fish is expected from use of B.t.k. (EPA 1998).

B.t.k. has not been observed to have negative effects on frogs and salamanders (Extension Toxicology Network 1988). While no toxicity data is available on reptiles and amphibians, B.t.k. is not believed to pose a hazard to these organisms either (EPA 1998).

A study of the effects of B.t.k. on soil micro-fauna found a moderate increase in the number of soil bacteria, actinomycetes, fungi, and nematodes. In another study, B.t.k. was found to reduce populations of a predatory mite species (USDA 1995).

Effects of TM-BioControl on Fish and Wildlife

The application of TM-BioControl can be expected to result in exposure to a wide variety of birds, mammals, fish, and aquatic invertebrates. All available avian and aquatic data, and other relevant literature and information, show that the virus does not cause adverse pathogenic or toxic effects on avian, mammalian, or aquatic wildlife (EPA 1996). A study to assess the pathogenicity of virus in rainbow trout fry showed that no toxicity was apparent (SERA 1999). In another study, Chinook salmon, Coho salmon, and steelhead trout showed no effects when exposed to the virus by three different routes (Banowetz, 1976). No mortality were seen when the virus was fed to mallard ducks, house sparrows, bobwhite quail, and black-capped chickadees. No adverse effects were seen in brown trout, bluegill sunfish, and a variety of aquatic invertebrates. Similarly, tests with mule deer, Virginia opossums, short-tailed shrews and white-footed mice, resulted in no evidence of pathogenicity or toxicity (EPA 1996). Scientific literature also demonstrates that the virus

does not have adverse effects on honeybees and does not pose a significant risk to non-target insects (EPA 1996).

Due to the lack of adverse effects on avian, mammalian, and aquatic wildlife, plants, and non-target insects, EPA has found TM-BioControl poses minimal to no risk to non-target wildlife, including endangered species (EPA 1996).

ISSUE 7: WATER QUALITY

As mentioned in the discussion on Water Quality, page IV-13, there are three water quality criteria that could be affected by tussock moth defoliation. They are stream temperature, sedimentation, and nitrogen. Several factors affect stream temperature (degree of defoliation, width, stream orientation, topography and channel characteristics), one of which is defoliation. Host type of 60% or greater would be needed to have a significant effect on temperature.

NO ACTION ALTERNATIVE

About 4,750 miles of streams would be unprotected in 60%-100% host type. Of these, 1,550 miles are *303(d)* listed for temperature and 70 miles are listed for sedimentation. There would be no significant changes due to defoliation on nitrogen levels or sedimentation. Cumulative effects include the increased risk of fire and severity of fire. If severe or moderate defoliation occurs, fuel availability, risk of ignition, and risk of larger fires could increase. If there was a severe fire after defoliation, there could be an increase in sedimentation.

PROPOSED ACTION

About 942 miles of streams with 60%-100% host type would be protected. That leaves about 5,700 miles unprotected. The potential for defoliation that could cause increased temperature in streams is less than the No Action alternative but the opportunity is still significant. The risk of fire described in the No Action alternative is less, but is still therein unprotected areas. However, the Areas of Concern as described in the Proposed Action would be removed from an increased risk.

EXPANDED PROTECTION ALTERNATIVE

About 4,990 miles of streams with 60%-100% host type would be protected. Around 710 miles would be left unprotected. This significantly reduces overall exposure for defoliation caused temperature increases and the risk of increased sedimentation from possible increased risk of fire.

TM-BIO-CONTROL ONLY ALTERNATIVE

The effects are the same as the Proposed Action.

ISSUE 8: ECONOMIC EFFECTS S FROM DECREASED TOURISM

NO ACTION ALTERNATIVE

The effect of tussock moth damage on high-use recreation sites would likely be more severe than in areas where recreation is dispersed over larger areas. Generally, the more intensively used and viewed a landscape is, the larger levels of scenic benefits at risk (Rosenberger, 1998). Recreation sites tend to have high levels of investment in infrastructure and services, leading to proportionally high losses in recreation value from the physical damage and nuisance effects of a tussock moth outbreak. Recreation sites include campgrounds, summer home areas, organization camps, visitor centers, viewpoints, and other places of concentrated recreation use. Campers are often the first to complain about the presence of the tussock moth. Larvae and their fecal pellets fall on picnic tables, cars, and tents, causing considerable annoyance to campers (Wickman & Renton 1975). Sites that are especially unique, popular or have high capacity may suffer the most loss because comparable substitute sites are not available. A good example of this situation is a National Park. Nuisance effects from a 1998 Douglas-fir tussock moth outbreak experienced at Kings Canyon National Park in California include: reduced camper nights and revenue; reduced overnight stays in lodging businesses; reduced number and duration of day-use visitors; loss of revenue for concessionaires because of lower day use; and revenue losses to private businesses that serve receptionists. The National Park Service found a decline of nearly 2,000 occupied overnight camping spaces for the period July 1 - September 10, 1999. Due to nuisance effects, the National Park Service found that concessions operators were granting refunds when requested by guests who considered the rooms in the lodge unsatisfactory because of the presence of caterpillars (USDI 1999). Saddle stock in the Park was also affected. A commercial stable operator closed four weeks early because of the problems encountered in dealing with the outbreak, resulting in an estimated $20,000 loss in gross revenues (USDI 1999). The Park Service believed that many camping parties had intended to spend more than one night in the area left early because of the highly visible effects of the larval population. Approximately 100 visitors requested medical assistance or advice because of skin rashes or other minor allergic reactions over the course of the summer, believed to be associated with Tussockosis. A few visitors requested a refund of camping fees after spending a night.

Costs associated with tree damage in recreation sites include the diminished recreation experience and the cost of removing and replacing lost trees. Studies show that larger trees and a variety of tree species are positively correlated with higher benefit levels. The presence of visible damage, dead, and dying trees, and smaller average tree size that can result from tussock moth damage has an impact on recreation (Rosenberger, 1997). The impact of insects feeding on trees in recreation sites needs to be evaluated in terms of the loss of shade, screening, and esthetic qualities. Dead trees and tops from top-killed trees often need to be removed from recreation sites because they are hazardous. The costs of removing hazardous trees are in addition to the replacement costs associated with restoring vegetation in camp units (Wickman & Renton 1975). Because of the lost amenity values, neither the hazard removal cost nor the replacement cost may adequately represent the lost

recreation benefits associated with damaged sites. For example, Sequoia and Kings Canyon National Parks, predicted "many trees would be lost in the campground and other development areas. Many of these would be large, old-growth trees, which would not be replaceable in our time (USDI 1999)." Generally, the loss of recreation benefits would accrue until replacement trees grow to sufficient size to mitigate the damage caused by the insects (Wickman and Renton 1975)."

Substantial numbers of high-use developed areas in host type could be affected on all the forests of eastern Washington and eastern Oregon. No effects are expected in southern Oregon.

PROPOSED ACTION

All high use recreation sites in host type would be protected from tussock moth impacts. The features that attract people to these sites would be preserved and loss of income opportunity to those nearby communities would be less than the No Action alternative. The spray action would generate local income.

EXPANDED PROTECTION ALTERNATIVE

Under this alternative, the effect of tussock moths on people would be minimized and the spray operation could generate local revenue. Economic benefits would be roughly proportional to the number of acres sprayed, though the actual economic benefit cannot be accurately determined.

TM-BIOCONTROL ONLY ALTERNATIVE

The effects are the same as the Proposed Action.

ISSUE 9: DOUGLAS-FIR TUSSOCK MOTH AS A FOOD SUPPLY FOR WILDLIFE

NO ACTION ALTERNATIVE

No Action could result in opportunistic feeding by wildlife on outbreak populations for one or two years. This abundance could increase reproduction and/or survival during the outbreak. When DFTM populations collapsed, wildlife species would return to feeding habits associated with non-outbreak conditions.

PROPOSED ACTION

Protection of selected Areas of Concern would result in returning the insect to non-outbreak levels. Wildlife species that feed on tussock moth would not be able to take advantage of high populations but would continue to eat available tussock moths as part of their normal diets. Unprotected areas with outbreak level populations would be available for opportunistic feeding and could offer the associated benefits.

EXPANDED PROTECTION ALTERNATIVE

Protection activities would return the insect to non-outbreak population levels. Wildlife species that feed on tussock moth would not be able to take advantage of high populations but would continue to eat available DFTMs as part of their normal diets. Since this alternative protects the maximum area, there would be fewer chances for opportunistic feeding in adjacent areas during the outbreak than other alternatives. Species that feed exclusively on moths and butterflies could experience severe food shortages in areas treated with B.t.k.

TM-BIOCONTROL ONLY ALTERNATIVE

Protection of selected Areas of Concern would result in returning the insect to non-outbreak levels. Wildlife species that feed on tussock moth would not be able to take advantage of high populations but would continue to eat available tussock moths as part of their normal diets. Unprotected areas with outbreak level populations would be available for opportunistic feeding and could offer the associated benefits.

ISSUE 10: OPERATIONS

There is the potential for accidents to occur on insect suppression projects. Increasing the size of the operation also increases the potential for accidents. Based on previous experience, standards, guidelines, and mitigation measures have been designed to prevent or reduce the possibility and impacts of future accidents. Potential accident examples include loss of control or damage to aircraft or the need for the pilot to activate the emergency release system and dump the insecticide load in an unplanned location. High concentrations of fuel and insecticide would be involved. Operation plans would be developed to minimize the opportunity for accidents and to mitigate and contain any spills that did occur. The probably place for spills or accidents is at airports, heliports, and heli-spots where equipment is operating. Accidents could also occur over the project site or in route to the project area. Travel ways could be selected to avoid stream crossings as much as possible.

Increased vehicle traffic could also increase the chances of an accident. Since almost all protection would take place in the early morning, most driving to/from the site would be in the dark or early dawn hours. This could increase the risk for a vehicle accident to occur. Driver safety and training would be addressed in the operations plan, and mitigation measures for local emergency personnel would be addressed in the project operations plan. Project operations spill plans would address appropriate equipment and actions needed in case of a spill.

The agency does not plan to close roads in the project area during operations. However, access could be restricted during actual spraying. Roads in the protection area would probably be posted to inform the public that the area is scheduled for protection. If other operations or activities occur in, or near the protection area, it might be necessary to coordinate with those operators to minimize heavy equipment traffic and accident risk. Access to actual staging areas and heliports would be restricted in order to maintain public safety and security. Daily operation briefings to project personnel would inform them of known activity in the area. Specific mitigation measures would be placed in the project operations plan.

Access and use of campgrounds in protection areas may be posted or restricted to minimize exposure to spray and to reduce potential accidents. Specific mitigation measures would be developed in the operations plan for these sites.

In order to minimize drift and achieve effective protection, operations aircraft generally fly low, often in 50 – 75' of the tree canopy. Depending on the size of the protection block, two spray aircraft could fly in tandem. An observation aircraft might also be used. The biological control agents would be applied in swaths, typically 90 – 150' wide depending on the aircraft used. Although the aircraft would not re-fly the same area, it could move back and forth in the same vicinity on several passes. Noise would be noticeable by people in residences, administrative sites, or recreating in or adjacent to a protection area. Most aircraft activity would occur in the morning, from just before first light until about mid-morning. There could be additional aircraft noise in the afternoon, when observation aircraft does reconnaissance of the next day's protection areas. Because of weather, timing, ore elevation, spray aircraft could be in the same vicinity for several days. Mitigation measures could help minimize the impact of aircraft noise. The path from the staging area to the protection area could avoid areas of potential noise disturbance. As with the potential for accidents, the size and location of protection areas in each alternative determines the extent of possible effects. Noise would not be an issue in the No Action Alternative since operations would not be conducted and equipment would not create noise.

In conclusion, the larger an operation, the higher the risk for accidents or spills. There are no guarantees that accidents or spills can be avoided, nor the effects from operations (such as noise or area closures) completely mitigated. However, the mitigation measures and procedures outlined above could minimize impacts and/or the likelihood of such events occurring.

No Action Alternative

Noise would not be an issue in the No Action Alternative since operations would not be conducted and equipment would not create noise.

The chance of accidents from extra vehicles would be reduced.

Proposed Action

Projects would be conducted on specific acres. There would be some opportunity for accidents and spills. Roads and campgrounds would be posted prior to treatment. There may be some short-term noise concerns, primarily over high-use and residential areas.

Expanded Protection Alternative

This alternative identifies a large number of acres to be protected. The opportunity for accidents, spills and noise concerns would increase because of increased numbers of people and equipment on the project.

TM-BioControl Only Alternative

Effects would be the same as for the Proposed Action.

Issue 11: Secondary Mortality from Bark Beetles

In general, bark beetles prefer stressed and weakened trees. When a disturbance, such as a fire or wind storm occurs, the beetles attack damaged trees and produce high numbers of offspring. Subsequent generations attack and kill healthy trees as the supply of stressed trees diminishes. Old-growth stands are highly susceptible to Douglas-fir bark beetle outbreaks because the large, slow-growing trees are often already under stress from competition with other trees and vegetation.

Mortality from bark beetles is correlated to defoliation but is influenced by environmental conditions proceeding and during the outbreak (Berryman and Wright, 1978; Wickman, 1979). In some cases, more mortality can be attributed to the beetles than to tussock moth. Douglas-fir suffers proportionally higher mortality than other host species because it suffers higher levels of defoliation and has a high secondary mortality rate from bark beetles. One study found that if a stand contained more than 50% Douglas-fir, the stand mortality more than doubled (Wickman, 1978). Douglas-fir bark beetles prefer large trees and therefore, almost all beetle mortality occurs in dominant and co-dominant trees. Mortality from other causes has been recorded as well: fir engraver, fir borers, dwarf mistletoe, and other unknown factors (Wickman, 1958; Beveridge, 1981). In general, stands which suffer the most significant mortality from bark beetles are those receiving moderate to heavy defoliation, with a stand composition of 50% or more Douglas-fir, and with a stand structure which consists primarily of dominant and co-dominant host trees.

Because of the "clumpiness" of a Douglas-fir tussock moth outbreak, most mortality usually occurs in patches rather than scattered throughout a stand. Patch size can vary from several hundred to several thousand acres. Where Douglas-fir beetle populations are already elevated (particularly on the Newport Ranger District, Colville NF, and on parts of the Wallowa-Whitman and Malheur NFs), significantly higher additional mortality from bark beetles in defoliated areas is expected

Treatment with either B.t.k. or TM-BioControl could prevent some secondary mortality. Since moth larvae are actively feeding at the time of treatment, not all defoliation would be prevented and some trees would become susceptible to secondary attack. Although protection would not prevent all mortality from these additional forces, less mortality would occur than without protection. Bark beetle populations would not increase in large numbers of susceptible trees and mortality in subsequent years would not be as significant.

No Action Alternative

Maximum defoliation and subsequent bark beetle mortality would occur. Additional mortality from bark beetles

would probably be 6 - 43%, depending on stand and environmental conditions. High-risk areas would experience the most mortality.

PROPOSED ACTION

Protected areas would experience less additional mortality than unprotected areas where additional mortality would be mostly in larger trees. Any trees defoliated prior to protection would still be susceptible to beetle attack; additional measures to protect these trees against Douglas-fir beetle mortality might be necessary.

All areas outside of the protection area would experience bark beetle mortality as described in the No Action Alternative. High risk sites would be at greatest risk.

EXPANDED PROTECTION ALTERNATIVE

This alternatives would protect more acres than other alternatives. Subsequent bark beetle mortality would be less.

All areas outside of the protection area would experience bark beetle mortality as described in the No Action Alternative. The greatest risk is on high-risk sites for defoliation.

TM-BIOCONTROL ONLY ALTERNATIVE

Effects would be the same as in the Proposed Action.

OTHER: AREAS OF CONCERN IN WILDERNESS

Regulations and policy allow for control of insects and disease in Wilderness IF:

- It is necessary to prevent unacceptable damage outside the Wilderness.
- It is to maintain or restore habitat for threatened, endangered, or sensitive species.
- It is to control an unnatural loss from exotic species.

Two Areas of Concern have been included in Wilderness for analysis in the Proposed Action:

1) *An area along a portion of the Wolf Creek drainage in the Lake Chelan-Sawtooth Wilderness (5,850 acres).* The effects of defoliation from the tussock moth could create an increase in fuels and subsequent risk of fire that would result in an unacceptable to the resources and property outside the Wilderness. Treatment of the moth to prevent such effects may not be possible without also treating that portion of the drainage in Wilderness. Treatment would only include the minimum needed to protect the above-identified values outside the Wilderness. In addition, treatment would only occur if the moth reaches sub-outbreak / outbreak levels. (Refer to the effects analysis in the "Fire" section, page IV-11.)

2) *An area in the North Fork Umatilla Wilderness in that river's watershed (5,890 acres).* This area contains Columbia River bull trout, a species listed as threatened by the US Fish & Wildlife Service. Defoliation by the tussock moth could result in a loss of shade and an increase stream temperatures, which would result in important spawning and rearing habitat area being degraded. (Refer to the analysis found in the "Fish and Wildlife: Threatened & Endangered Species" section, page IV-15.) Defoliation in the upland areas of this watershed would increase fuels and risk of fire, which in turn would result in an unacceptable risk of increased and sedimentation into the river system. (Refer to the effects analysis in the "Fire" section.)

OTHER CONCERNS: EFFECTS ON ADJACENT LANDS (I.E. SPREAD OF MOTH POPULATIONS)

DFTM populations arise in-place. Limited dispersion can occur if very small caterpillars are blown in the wind. The fact that the female does not fly allows protection of specific areas without concern for reinvasion. Outbreaks occur because DFTM populations are already on site and conditions are favorable to population explosion. The "boom and bust" characteristic of DFTM outbreaks means the population does not resurge to outbreak level again after protection, much less spread to adjacent ownerships.

There is little danger for spread of DFTM from unprotected onto protected lands or from infected lands to uninfected adjacent lands, regardless of the number of acres protected.

OTHER CONCERNS: CUMULATIVE EFFECTS OF TREATMENT

PREVIOUS FOREST INSECT SUPPRESSION PROJECTS

Large-scale forest insect suppression projects have been conducted at various times throughout eastern Washington and Oregon for over 50 years, primarily for western spruce budworm, and in a couple instances, for Douglas-fir tussock moth. These projects occurred on all ownerships including National Forest, Indian Reservation, and State and private lands. Earlier projects from 1948 to 1974 used DDT (Graham, et. al., 1975; Dolph, 1980). Later projects conducted in 1975 to 1983 used chemical insecticides. The primary insecticides used were Malathion™ and carbaryl, although smaller experimental projects testing the effectiveness of insecticides such as fenitrothion, matacil, and acephate were also conducted in the mid-70s (Dolph, 1980; Sheehan, 1996a, Sheehan, 1996b). Since 1984, with the exception of some carbaryl use on private lands, B.t.k. has been used almost exclusively (Ragenovich, 1988; Sheehan, 1996a; Sheehan, 1996b). Projects varied in size from 80 acres treated for experimental use, to over 930,000 acres treated operationally in one year. The largest projects occurred in 1950 (933,300 acres) and 1951 (936,600). The most recent projects were in 1999 on the Yakima IR and adjacent State and private lands (45,000 acres).

Treatments on forest areas were often widely separated in space and time. Over this 50-year period, some areas have been treated only once and more often twice. A few areas have been treated up to four times. Western spruce budworm outbreaks often last for 7-13 years. Annual

suppression projects were conducted during the outbreak period, but the same areas generally were not treated more than once during that outbreak. Many of the areas treated in earlier outbreaks are not being considered in this analysis. This includes projects conducted in 1940-52, 1962, 1974, 1988-90, 1993, and 1999 on parts of the Willamette and Mt. Hood National Forests, and Warm Springs, Yakima, and Colville Indian Reservations, and State and private lands throughout eastern Washington and Oregon. Most treatments on State and private lands were done in conjunction with the larger treatment programs that included National Forest lands that same year.

The earlier treatments, primarily with DDT and chemical insecticides, were not monitored for effects on any insects other than the target insect, nor is it likely that any monitoring was done on other fauna. Certainly almost all of the insect fauna and most likely other fauna, such as birds and species that rely on insects for food, would have experienced effects from the treatments of this broad-spectrum insecticide. Any assumptions regarding these effects would be purely speculative.

There are some underlying guidelines regarding this analysis:

- Effects from any treatments 20 years ago would no longer be evident. Species either would have recovered to pre-treatment levels or other ecosystem/climatic would have influenced insect population changes in such a way that the treatment impacts would have been negated.
- If a species had been extirpated in previous projects, it remains extirpated.
- Monitoring of treatment effects on target species (i.e. western spruce budworm) for both carbaryl and B.t.k. indicates that lasting population suppression does not occur. Although this is an indication a populations ability to recover, it cannot be assumed that other species would respond in the same way.
- A number of recent studies on non-target Lepidoptera show that these insects return to pre-treatment levels – both in species richness and population numbers in 2-3 years. This recovery is likely due to a resurgence of populations in place and movement of populations from untreated into treated areas. A conservative estimate of 5 years has been used in this analysis.
- Percentages of acres previously treated and those that are currently being analyzed are estimates of relationships.
- TM-BioControl would not result in any effects to other insects. B.t.k. would have effects on other Lepidoptera.

The following discusses the approximate locations of treatments in previous years and the approximate percent of those areas included in the current analysis.

COLVILLE NATIONAL FOREST

No areas on the Colville NF have been treated previously. No cumulative effects from previous treatments could be expected under any action alternative.

OKANOGAN NATIONAL FOREST

No areas on the east side of the Okanogan Forest have been previously treated. No cumulative effects from previous treatments could be expected under any action alternative.

On the west side of the Okanogan Forest, some areas were treated for western spruce budworm in 1976 and 1977. About 50% of the area treated in 1976 was retreated in 1977, along with additional acres. Malathion™ was used in 1976, and carbaryl (Sevin-4-Oil™) was used in 1977. There have been no insect suppression projects on the Okanogan in the last 22 years.

The Proposed Action and the TM-BioControl Only Alternative analyze potential effects on specific Areas of Concern. Approximately 70% of the areas currently proposed for protection were treated in 1976 - 1977. The remaining 30% have never been treated.

The Expanded Protection Alternative includes lands proposed for protection in the Proposed Action plus all other areas with 60-100% host type. Most of the area treated in 1976/77 is included in this alternative.

There are no cumulative effects from previous and proposed treatments.

WENATCHEE NATIONAL FOREST

Previous projects on the Wenatchee NF included one small project in 1951 using DDT. The treatment area was located just west of Leavenworth. Areas between Cle Elum and Leavenworth were treated in 1976 and 1977 with Malathion™ and carbaryl. In 1987, an area around Rimrock Lake was treated with B.t.k. to control western spruce budworm.

About 80% of the area in the Proposed Action has been previously treated. None of 1951 acres are included in the current analysis. Almost all of the current analysis area was treated in 1976 and/or 1977. These are the areas north of Leavenworth and between Cle Elum and Leavenworth. The Proposed Action could retreat approximately 30% of the area treated in 1976/1977. There would be no cumulative effects from these previous treatments because of the treatment interval (22 years minimum).

The area treated in 1987 had not been previously treated. It includes a cluster of Areas of Concern in the most southern part of the Forest. The current Proposed Action could retreat approximately 40% of the 1987 treatment area. There would be no cumulative effects to non-target Lepidoptera if all or part of this area is retreated.

Treatments with DDT in 1962 and B.t.k. in 1990 occurred on the south part of the Yakima Indian Reservation. The most recent western spruce budworm treatments on State, private, and tribal lands (1996-1999) are 20-50 miles from the area analyzed in this EIS. It is expected that there

would not be cumulative effects to non-target Lepidoptera because of the distances between treatment areas.

UMATILLA NATIONAL FOREST

Almost all of the Umatilla Forest was treated with DDT for western spruce budworm between 1951 and 1953. Almost all of the Forest south of Heppner and east of Ukiah was retreated in 1982/1983 with carbaryl. In addition, portions of the Forest south and north of Ukiah were treated. Areas of Concern identified in this analysis comprise just 5% of the area treated in 1982/1983. Since the Expanded Protection Alternative includes most host type, this alternative could retreat 75% of the 1982/1983 area. Most of the southern half of the Umatilla Forest has not been treated since 1983.

In addition to treatments in the 1950s, portions of the north half of the Umatilla were treated with DDT in 1974 to control Douglas-fir tussock moth. Scattered areas southeast, east, and northeast of Pendleton were retreated 1988 and 1992 with B.t.k. for western spruce budworm. About half of the 1988 area (southeast of Pendleton) was retreated in 1992. Using the 5-year recovery assumption, there could have been adverse cumulative effects on non-target Lepidoptera in those areas treated in 1988 and again in 1992. The Proposed Action could retreat 5 % of the 1988 or 1992 area. The Expanded Protection Alternative could retreat 80% of those areas.

About half of that portion of the Umatilla Forest that lies in southeast Washington was treated in the early 1950s with DDT. A small portion on the eastern edge of the Forest was retreated in 1974 for Douglas-fir tussock moth. A small area, northeast of Walla Walla, was treated with B.t.k. in 1992. Some Areas of Concern included in the Proposed Action are in this area. Approximately 50% of the area in the Expanded Protection Alternative was included in the 1950s treatment.

The most recent treatments on the Umatilla Forest were with B.t.k. 8 years ago. Therefore, there would be no cumulative effects on non-target Lepidoptera.

WALLOWA-WHITMAN NATIONAL FOREST

Nearly all Areas of Concern in this analysis have been previously treated on the Wallowa-Whitman Forest during the last 50 years. Some portions on the southern half (south of La Grande and west of Baker City) were treated in 1950, 1954, 1955, or 1958 with DDT for western spruce budworm. None of these areas was treated more than once during that time. None of this part of the Forest has been retreated.

Parts of the Forest, northeast of Baker City and east of LaGrande, were also treated in the early 1950s with DDT for western spruce budworm. Some of this area was retreated for Douglas-fir tussock moth in 1974, and again in 1991 with B.t.k. Additional areas were treated in 1992 with B.t.k. for western spruce budworm. Areas treated in 1991 were not retreated in 1992. Some areas south of the Eagle Cap Wilderness were treated in the 1950s, in 1974, and in 1991.

Under the Proposed Action, 90% of the 1991 area and 5% of the 1992 area could be retreated. Under the Expanded Protection Alternative, retreatment could occur on 85% of those areas. Some other areas in the Expanded Protection Alternative, specifically those northeast and northwest of the Eagle Cap Wilderness, and north of Enterprise, have only been treated once, in 1974 or in 1992.

The most recent treatments on the Wallowa-Whitman Forest were 8 years ago with B.t.k. Due to the treatment interval (not less than 8 years), there would be no cumulative effects on non-target Lepidoptera.

MALHEUR NATIONAL FOREST

Extensive portions of the Malheur NF were treated with DDT in 1955 or in 1958. Portions of the Forest were treated again, primarily with carbaryl, in 1982 and 1983. More areas were treated with B.t.k. in 1985 and 1987. About 10% of the area treated in 1982/1983 was retreated in the 1985 and 1987 projects. The area treated in 1985 is southwest of John Day. Areas of Concern in the Proposed Action comprise about 15% of the 1985 areas. The Expanded Protection Alternative could retreat an additional 20% of the 1985 area.

The 1987 treatment area is mostly north of John Day with some scattered areas throughout the Forest south of John Day. The Proposed Action could retreat areas southeast of John Day and south of the Strawberry Wilderness that were treated in the 1950s. In addition, small Areas of Concern north of John Day were treated in 1987. The Expanded Protection Alternative could retreat approximately 75% of the 1987 treatment area. Areas of Concern northeast, east, and southeast of John Day were not included in the 1987 treatment, but many were included in the 1982/1983 treatments.

In summary, most areas proposed for protection have been previously treated. However, no adverse cumulative effects to insects are expected because of treatment interval length (12 years minimum).

OCHOCO NATIONAL FOREST

The northern part of the Ochoco National Forest was treated with DDT in 1955. Approximately 80% of Areas of Concern in this analysis were treated in 1955; however, the new protection areas comprise 40% of the 1955 treatment zone. Since the most recent treatment occurred 45 years ago, there would be no cumulative effects.

WINEMA NATIONAL FOREST

No areas on the Forest have been treated previously. There would be no cumulative effects.

FREMONT NATIONAL FOREST

No areas on the Forest have been treated previously. There would be no cumulative effects.

Other Forest uses

In addition to these projects, various smaller projects have been conducted. These projects included activities such as control insects in high value seed orchards. These treatments were occasional and limited in size, and would not result in cumulative effects.

Activities outside National Forests

In addition to the insect suppression activities on the National Forests, insect suppression activities on adjacent lands could affect insect, and specifically, Lepidoptera. Private land owners may decide to take action to control Douglas-fir tussock moth outbreaks on their lands. Since TM-BioControl is not available to them, they would have to use a currently registered insecticide, such as B.t.k., tebufenozide, diflurbenzuron, or carbaryl. B.t.k. and tebufenozide would affect other Lepidoptera; diflurbenzeron and carbaryl would also affect other insects.

Many of the areas adjacent to or near National Forest lands are agricultural. These agricultural uses include a variety of vegetable products, grain crops and corn, and fruit orchards. People living in the vicinity may have gardens, lawns, and trees. Insecticides of various kinds will be used, either in limited quantities (as in the case of homeowners) or more extensively (as in the case of agricultural products). Individual uses could accumulate into a significant amount and may have an impact on overall insect populations. Large insect suppression projects for grasshoppers on rangeland have occurred in the past and may have occurred on or adjacent to National Forest lands.

In addition, native insects most likely have been affected by removal of their host plants or conversion of their habitats. Conversion of habitat would include such things as expansions of residential areas into previous habitats such as meadows, conversion to agricultural uses, or invasive weeds, displacing their native host plants.

Summary of Cumulative Effects

In the past 50 years, insect suppression projects have occurred on many areas being considered in this analysis. Treatments have often been greatly separated by distance and time. The most extensive projects were conducted in the 1950s when DDT was used to treat western spruce budworm. Later projects in the mid-70s to early 80s used insecticides such as carbaryl, Malathion™, and acephate. The most recent projects, from the mid 1980s to 1993, used B.t.k. Most of the Areas of Concern being analyzed have been treated at least once before; some have been treated more than twice. In a few cases, areas have been treated 3-4 times. It is estimated that about 90 Areas of Concern identified in this analysis have been treated at least once in the past 50 years.

Treatments occurring more than 20 years ago would not likely to be evident. Lepidoptera species either would have recovered to pre-treatment levels or ecosystem changes would have influenced insect population changes in such a way that treatment impacts would have been negated. In addition, it is likely that Lepidoptera populations that were affected by previous treatment would recover in 5 years.

The Colville, Winema, and Fremont Forsets have never been treated in large-scale forest insect suppression projects, so areas considered in this analysis would not be subjected to cumulative effects from previous projects. Areas on the Okanogan, Wenatchee, and Ochoco Forests have only been treated once. Areas on the Ochoco were treated in the early 1950s; areas on the Okanogan were treated in 1976-77. Most Areas of Concern on the Wenatchee NF were treated once, in 1976-77. One area near Rimrock Lake was treated in 1987. Most of the suppression project activity occurred on the Umatilla, Malheur, and Wallowa-Whitman NF's. A large portion of both of these Forests was treated in the early 1950s. Much of this same area on the Malheur and Umatilla Forests were treated again 30 years later (in the early 1980s) with carbaryl. Additional projects using B.t.k. were conducted on in the late 80s and early 90s. The last treatment conducted on any of the areas in this analysis was in 1993.

Because of the time between treatments, it is estimated that cumulative impacts from the current project on other insects would be minimal. In addition, many native insects have been affected by removal of their host plants or conversion of their habitats (expansion of residential areas into meadows, conversion to agricultural uses, invasive weeds displacement, etc.).

No Action Alternative

There would be no cumulative effects from the No Action Alternative.

Proposed Action

Depending on location and proximity of private lands and frequency of other insecticides used, there could be some localized cumulative effects, mostly on non-federal lands. Overall, there would be no cumulative effects on National Forest lands.

Expanded Protection Alternative

Depending on location and proximity of private lands and frequency of other insecticides used, there could be some localized cumulative effects, mostly on non-federal lands. The larger area and additional use of B.t.k. increases possibility of overall cumulative effects.

TM-BioControl Only Alternative

No cumulative effects are anticipated from this alternative.

Other Concerns: Benefits and Cost of Operations

The benefits of this operation are the resources protected in the various alternatives. A summary of those benefits can be found in Chapter II, Comparison of Alternatives table.

The cost of a Douglas-fir tussock moth spray project would include the cost of the operational aircraft, insecticide and/or mixture components, support equipment,

insect and environmental monitoring crews, and administrative costs. Costs vary by contractor bid, cost of materials, and logistics of implementation. It is estimated that the cost of this project would be similar to previous western spruce budworm projects. Although the Forest Service owns TM-BioControl, the cost of the molasses and sunscreen, additional handling and mixing, and higher volume per acre application rate, or the purchase of 038 carrier, would probably make the actual cost per acre for both insecticides similar. It is estimated that the total cost of a Douglas-fir tussock moth protection effort would be $15 - $25 per acre.

No Action Alternative

No operational costs would be incurred.

Proposed Action

Most of the protection areas would probably be irregularly shaped or small, requiring more flight time and movement of equipment in relation to the number of acres protected. In addition, since commercial insecticide is produced in bulk, smaller quantities could be more expensive than

larger ones. These factors could increase the overall cost of the project.

Estimated Cost = $4.5 – 7.5 million for treatment on 300,000 acres; worst-case: $8.4 – 14.0 million.

Expanded Protection Alternative

Many of the protection areas would be large, lending themselves to easier application. Less time would be spent flying and in moving equipment around in relation to the number of acres protected. More material could be purchased in bulk. It is expected that the cost per acre for this alternative would be less than the Proposed Action.

Estimated Cost = $10.5 – $17.5 million for treatment on 700,000 acres; worst-case: $37.7 - $62.9 million.

TM-BioControl Only Alternative

Estimated Cost = $4.5 – 7.5 million for treatment on 300,000 acres.

CLIMATE

Global changes have been a concern in the last decade. Evaluation of global climate change in a small project level document would be speculative and is beyond the scope of this project. Research is being conducted on a broader scale, which includes the implications of Forest management activities. This document is not an appropriate way to address the global change issue.

PRIME FARMLAND, RANGELAND, AND FORESTLAND

The areas being considered for protection under this document do not contain prime farmlands or range lands. "Prime" forestland is a term used only for non-federal land and does not apply to lands in the National Forest System.

MINORITY GROUPS, WOMEN, AND CIVIL RIGHTS

All action alternatives propose a strategy for dealing with an expected tussock moth outbreak in eastern Washington and Oregon. With this strategy, several thousand acres of National Forest land would be protected with insecticide(s). It is anticipated that none of these alternatives would have a direct effect on minority groups, women, or civil rights.

The indirect effect of these alternatives could be an opportunity for employment. The Expanded Protection Alternative would provide the greatest opportunity for employment since more acres could be protected. Employment could include insecticide application, supply of materials, and other business support functions. With the No Action Alternative, there would be no opportunity for project-related employment.

UNUSUAL ENERGY REQUIREMENTS

Implementing action alternatives would require consumption of fossil fuels by aircraft and ground-based support vehicles. Except for the conservative use of operational vehicles, no major opportunities for energy conservation were identified.

IRREVERSIBLE AND IRRETRIEVABLE COMMITMENT OF RESOURCES

An irreversible commitment of resources results from a decision to use or modify resources that is renewable only over a long period. No irreversible commitment of resources has been identified.

An irretrievable commitment of resources would occur when opportunities are foregone for the period that the resource could not be used. No irretrievable commitment of resources has been identified.

WETLANDS AND FLOODPLAINS

Wetlands and floodplains would be affected by all alternatives. The No Action Alternative would not protect any riparian areas along any wetlands and flood plains. Under the Proposed Action and TM-BioControl Only Alternative, Areas of Concern along wetlands and floodplains would be protected to prevent defoliation. Riparian areas along other wetlands and floodplains would not be protected and defoliation could occur. The Expanded Protection Alternative would protect riparian areas along all wetlands and floodplains. The specific effects of each alternative on wetlands, floodplains, and dependent wildlife is discussed in detail in this analysis.

POTENTIAL CONFLICTS WITH PLANS AND POLICIES OF OTHER JURISDICTIONS

There are no conflicts expected between the action alternatives and the plans and policies of other agencies.

ENVIRONMENTAL JUSTICE

On February 11, 1994, President Clinton signed Executive Order 12898. This order directs each federal agency to make achieving environmental justice part of its mission by identifying and addressing, as appropriate, disproportionately high and adverse human health or environmental effects of its programs, policies, and activities on minority populations and low-income populations. The President also signed a memorandum on the same day, emphasizing the need to consider these types of effects during NEPA analysis.

On March 24, 1995, the Department of Agriculture completed an implementation strategy for the executive order. Where Forest Service proposals have the potential to disproportionately adversely affect minority or low-income populations, these effects must be considered and disclosed (and mitigated to the degree possible) through the NEPA analysis and documentation.

Effects of alternatives on the human environment (including minority and low-income populations) are disclosed in the Effects on Human Environment section. Effects are expected to be similar for all human populations, regardless of nationality, gender, race, or income.

CHAPTER V: LIST OF AGENCIES, ORGANIZATIONS, AND PERSONS

INTRODUCTION

As part of the scoping process, Forests mailed a questionnaire to people on their respective mailing lists. On this form, respondents were asked to answer four questions. At the bottom of this form, respondents were asked to indicate if they 1) wanted to be on the EIS mailing list, 2) if they wanted a copy of the full EIS, and 3) if they did not want a full copy of the EIS, did they want a copy of a summary. The majority of respondents indicated they preferred a summary rather than the complete document. Additionally, a few respondents indicated they did not want to be on the project mailing list. The names of the people not wanting on the mailing list do not appear in the lists below.

The following lists identify the agencies, organizations and persons to whom full copies or summaries of the DEIS were sent and to whom the Final EIS will be sent. For a full discussion of the public involvement process, please refer to Appendix C.

FEDERAL AGENCIES AND DEPARTMENTS

Advisory Council on Historic Preservation
- Western Office of Review

U.S. Department of Agriculture
- USDA, OPA Publications Stockroom
- Animal & Plant Health Inspection Service
- Office of Equal Opportunity (OEO)

US Department of Interior
- Crater Lake National Park, Crater Lake, OR
- US Fish &Wildlife Service, Little Pend Oreille National Wildlife Refuge, Colville, WA
- US Fish and Wildlife Service, North Pacific Coast Ecoregion, Lacey, WA

US. Department of Commerce
- Director, Ecology and Conservation Office
- National Marine Fisheries Service (Portland, Oregon)

US. Department of Defense
- North Pacific Unit, COE division (Portland, Oregon)

US. Department of Energy
- Director, Office of Environmental Compliance

US Environmental Protection Agency
- Regional Office, Region 10 (Seattle, Washington)

Federal Aviation Administration
- Northwest Regional Office, Renton, Washington

Federal Energy Regulatory Commission
- Advisor on Environmental Quality

Federal Highway Administration
- Regional Administrator, Region 10 (Portland, Oregon)

Federal Railroad Administration
- Office of Transportation and Regulatory Affairs

General Services Administration (GSA)
- Office of Planning and Analysis

US Department of Housing and Urban Development (Seattle, Washington)

US Department of Housing and Urban Development (Portland, Oregon)

US Department Of Interior
- Director, Office of Environmental Policy and Compliance

Surface Transportation Board
- Chief, Energy and Environment

Northwest Power Planning Council (Portland, Oregon)

Pacific Northwest Region – USDA Forest Service
- Environmental Coordinator

NATIVE AMERICAN CONTACTS

The Klamath Tribe
Confederated Tribes of the Warm Springs
Confederated Tribes of the Colville
Confederated Tribes and Bands of the Yakima
Kalispell Indian Community
Nez Pierce Tribe
Confederated Tribes of the Umatilla
The Spokane Tribe
Burns Paiute Tribe

OREGON NATURAL RESOURCE AGENCIES

Department of Fish and Wildlife
Water Resources Department
Department of Land Conservation and Development
State Economist
Governor's Forest Advisor

Parks and Recreation Department
Department of Environmental Quality
Rural Development Section
Forestry Department

WASHINGTON NATURAL RESOURCE AGENCIES

Governor's Office – Executive Policy Office
Department of Health
Department of Natural Resources
Department of Fish and Wildlife
State Parks and Recreation Commission

Respondants

Government Agencies, Businesses, Organizations, and Citizens who responded during the Public Scoping comment period:

49 North Ski Area, Chewelah, WA

Alliance for the Wild Rockies, Missoula, MT

Blue Mountain Biodiversity Project, Fossil, OR

Blue Mountain Lumber Products, Pendleton, OR

Bureau of Land Management (BLM), John Day, OR

Superintendent, Crater Lake Nat'l Park, Crater Lake, OR

City Recorder/Manager, Canyon City, OR

Eastern Oregon Sportsman Assoc., John Day, OR

Evergreen Helicopters, Mcminnville, OR

Forest Resource Services, Salem, OR

Glide Lumber Co./Western Timber Co., Glide, OR

Grant County Conservationists, John Day, OR

Grant County Court, Canyon City, OR

Haglund, Kirtley, Kelly, and Horngren, Portland, OR

Hells Canyon Preservation Council, La Grande, OR

Heppner Chamber of Commerce, Heppner, OR

Kettle Range Conservation Council, Republic, WA

KPLV, Environmental Beat, Seattle, WA

Kralman Steel Structures, Milton Freewater, OR

Little Pend Oreille National Wildlife Refuge, Colville, WA

Longview Fiber Company, Longview, WA

Malheur Lumber Company, John Day, OR

Malheur Timber Operators Inc., John Day, OR

Methow Valley Snowmobile Assoc., Winthrop, WA

Natural Resources Research Library, Logan, UT

NW Coalition for Alternatives to Pesticides, Eugene, OR

Northwest Forestry Assoc., Portland, OR

Ochoco West Water District, Prineville, OR

Okanogan County Snowmobile Club, Brewster, WA

Oregon Natural Res. Council, Eugene and Portland, OR

Oregon Heirs Corp., Sylnar, CA

Oregon Public Lands Action Committee, Lakeview, OR

Prairie Wood Products, Prairie City, OR

Mayor, City of Republic, Republic, WA

Roseboro Lumber Co., Bend, OR

Susee's Skyline Packers Inc., Tacoma, WA

US Fish & Wildlife Service, North Pac. Coast Ecoregion, Lacey, WA

V.P. Harney County High Desert Fur Takers, Burns, OR

Vaagen Brothers Lumber Co., Colville, WA

State Parks and Recreation Commission, Olympia, WA

Washington State Snow Mobile Assoc., Dayton, WA

Wallowa County Commissioner, Enterprise, OR

Wilderness Watch, Missoula, MT

Ahman J., Drewsey, OR

Barke C., Seattle, WA

Bigas P., Seattle, WA

Bowker L., Eureka, Ca

Brazeal J., Lakeview, OR

Burrows R., Kent, WA

Cameron D., Prineville, OR

Cannon R., Mitchell, OR

Cason J., Prineville, OR

Cheatham A., Union, OR

Chicken C., Walla Walla, WA

Copeland M., Anchorage, AK

Cook S., Eugene, OR

Crampton S., Twisp, WA

Cromwell B., Republic, WA

Culbertson G., Springfield, OR

Curtis R., Burns, OR

Donaca D., Prineville, OR

Dovenberg J., Sherwood, OR

KPLV, Environmental Beat, Seattle, WA

Erwin A., Ashland, OR

Ferm P., Monroe, WA

Finlayson S., Burns, OR

Fisher E., Eugene, OR

Foecke, D., Leavenworth, WA

Gabrielsen S., Hayden Lake, ID

Gebhandt C., Seattle, WA

Geisler D., Burns, OR

Gilbert B., Heppner, OR

Givler L., Vashon, WA

Glerup R., Hines, OR

Goodwin R., Eugene, OR
Gritman F., Dayton, WA
Harris E., Canyon City, OR
Herbst J., La Grande, OR
Higgins M., Halfway, OR
Hines J., Ventura, CA
Holmes S., Kimberly, OR
Humbert S., Milton Freewater, OR
Kazda G., Portland, OR
Kazda E., Portland, OR
Kazda J., Portland, OR
Kennedy R., Lakeview, OR
Kile L., Wenatchee, WA
Kinsel B., Seattle, WA
Klinger D., Leavenworth, WA
Kominski R., Leavenworth, WA
Kupillas E., Eagle Point, OR
Langdon J., Coeur D Alene, ID
Lee B., Wenatchee, WA
Lenox S., Lebanon, OR
Loe P., Seattle, WA
Looney B., Bend, OR
Loper B., Grants Pass, OR
Mallon M., Ardenvoir, WA
Marsh N., Salem, OR
Mason R., Corvallis, OR
Mcmillan B., Baker City, OR
Morrow A., Madras, OR
Mullin S., Prairie City, OR
Needles E., Sumpter, OR
Nelson D., Priest River, ID
Ostertag G., Keizer, OR
Paul S., Yakima, WA
Pedracini D., Sumpter, OR
Perkins E., Prineville, OR
Phillips D., Baker, OR
Pitz C., Olympia, WA
Porter D., Milwaukee, OR
Prowell D., Baker City, OR
Ritter J., Salem, OR
Rose R., Pasco, WA
Roufs R., Paulina, OR
Rourke M., Republic, WA
Sanowski B., Paulina, OR
Scott D., Ontario, OR
Scott P., Naches, WA
Secord D., Prairie City, OR
Seely L., Manzanita, OR
Smerski D., Burns, OR
Spitz J., Bend, OR
Still L., Canyon City, OR
Swatek S., Portland, OR
Taylor D., Hermiston, OR
Thomason M., Moses Lake, WA
Town S., Vale, OR
Vandehey R., Fossil, OR
Voigt P., Prairie City, OR
Watson G., Lewiston, ID
Weitman T., Tualatin, OR
Wenzler/Gilchrist, Winthrop, WA
Westerlund G., Kent, WA
Wiggins R., Joseph, OR
Williams J., Bend, OR
Williamson M., Colville, WA
Wilson L., Corvallis, OR
Yockim R., Roseburg, OR
Zita R., Pendleton, OR

The following table represents those that submitted comments on the draft EIS.

CATEGORY	NAME	CITY, STATE
Agency	County Court for Harney County	Burns, OR
Agency	State of Oregon, Department of Forestry	Salem, OR
Agency	State of Washington, Department of Health	Olympia, WA
Agency	State of Washington, Department of Natural Resources	Olympia, WA
Agency	US Environmental Protection Agency	Seattle, WA
Agency	US Fish & Wildlife Service, North Pacific Coast Ecoregion	Western Washington Office; Lacey, WA
Agency	Wallowa County Bd. of Commissioners	Enterprise, OR
Citizen	Arnie Arneson Cascade Woodlands	Wenatchee, WA
Citizen	Denise Bevacqua	Seattle, WA
Citizen	Susan Crampton	Twisp, WA
Citizen	Rodney L. Crawford Burke Museum	Seattle, WA
Citizen	Claire Hagen Dole Butterfly Gardeners' Quarterly	Seattle, WA
Citizen	Bruce Dunn RY Timber, Inc.	Joseph, OR
Citizen	C. Dean Finch	Caldwell, ID
Citizen	Jack Harper	Washougal, WA
Citizen	Helen Jones	Prineville, OR
Citizen	David M. Klinger	Leavenworth, WA
Citizen	David V. McCorkle, Ph.D.	Monmouth, OR
Citizen	Donald E. Miller	Enterprise, OR
Citizen	Ron Mitchell	Boise, ID
Citizen	George & Rhonda Ostertag	Keizer, OR
Citizen	Steve Paul	Yakima, WA
Citizen	Cheryl Petterson	Seattle, WA
Citizen	Lisa Philipps	Salida, CO
Citizen	Robert Michael Pyle	Gray's River, WA
Citizen	James R. Reed	Klickitat, WA
Citizen	Jeff Ritter	Salem, OR
Citizen	Ron Rommel	
Citizen	Howard Rotstein	Portland, OR
Citizen	Hubert B. Sager Vaagen Bros. Lumber, Inc	Colville, WA
Citizen	Jon H. Shepard Lepidoptera Biodiversity	Nelson, BC Canada
Citizen	John K. Spence	Battle Ground, WA
Citizen	S. Duane Town	Vale, OR
Citizen	Dean & Mary Warner	Portland, OR
Citizen	Gary Westerlund	Kent, WA
Citizen	Boyd Wickman	Bend, OR
Citizen	Maurice Williamson, ACF Consulting Forstry	Colville, WA
Citizen	Rich Zita	Pendleton, OR
Organization	Alliance for the Wild Rockies	Missoula, MT
Organization	Big Bend Economic Dev. Council	Moses Lake, WA
Organization	Hells Canyon Preservation Council	LaGrande, OR
Organization	Kettle Range Conservation Group	Republic, WA
Organization	Keystone Project	John Day, OR

CATEGORY	NAME	CITY, STATE
Organization	The Lands Council, also representing: National Forest Protection Alliance Forest Conservation Council Blue Mtn Native Forest Alliance Colorado Wild OR Natural Resources Council Tonia Wolf	Spokane, WA Missoula, MT Santa Fe, NM Baker City, OR Boulder, CO Bend, OR Bend, OR
Organization	League of Wilderness Defenders Blue Mtns Biodiversity Project, also representing: Blue Mtn Native Forest Alliance OR Natural Resources Council The Lands Council	Fossil, OR Baker City, OR Bend, OR Spokane, WA
Organization	Malheur Timber Operators, Inc.	John Day, OR
Organization	Northwest Ecosystem Alliance	Chelan, WA
Organization	Xerces Society	Portland, OR

LIST OF PREPARERS

The following is a list of Interdisciplinary Team (IDT) members and those who assisted the IDT in the development of the Douglas fir Tussock Moth Environmental Impact Statement.

NAME	AREA OF EXPERTISE	EDUCATION	YEARS OF EXPERIENCE
Interdisciplinary Team Members:			
Bill Funk	ID Team Leader	B.S. Forest Management M.F. Forest Economics	33
Iral Ragenovich	Entomology	B.A. Biology B.S. Forestry M.F. Forest Entomology	25
Connie Mehmel	Ecology, Silviculture	B.S. Resource Management	22
Nick Reyna	Decision Support	B.S. Forest Management M.S. Forest Policy	20
Don Davison	Writer / Editor (Draft EIS)	A.S. Forest Technology	29
Melanie Fullman	Writer / Editor (Final EIS)	B.S. Forestry	15
Judy Wing	Public Affairs	B.S. Forest Recreation	11
Sharon Phillips	Wildlife Biology	B.S. Fisheries & Wildlife	7
Geographic Information Systems Specialists			
Julie Johnson	GIS Analysis	B.S. Forest Management	15
John Nelson	GIS Computer Support	B.S. Computer Info Systems / Math / Business	13
Tuyen Ta	GIS Technical Info. Computer Support	A.A. Information Systems	9
Paul Zellmer	GIS Computer Analysis	B.S. Fisheries	35
Patty Johnson	GIS	Not available	
Specialists who assisted the Interdisciplinary Team			
Dave Bridgwater	Entomology	B.S. Forestry M.F. Forest Entomology	29
Bruce McCammon	Hydrology	B.S. Watershed Science M.S. Hydrology	28
Pam Ensley	Fire/Fuels (Draft EIS)	Not available	

NAME	AREA OF EXPERTISE	EDUCATION	YEARS OF EXPERIENCE
Peter Teensma	Fire Ecology (Final EIS)	B.A. Geography PhD. Geography (Biogeography)	19
Terry Slider	Recreation Planning	B.S. Landscape Architecture	23
Phil Mattson	National Environmental Policy Act (NEPA)	B.S. Forest Watershed Mgt	25
Dick Carkin	NEPA	B.S. Forest Production M.S. Forest Management	32
Roger Ogden	NEPA	Not available	
Katherine Sheehan	Insects & Disease WEB Site	B.S. Cons. of Natural Resources Ph.D. Entomological Sciences	17
Grant Gunderson	T, E & S Wildlife Biology	B.S. Conservation Biology	27
Scott Woltering	T&E Fish Biology	B.S. Fishery Science	20
Rex Holloway	Public Affairs	B.S. Forestry	22
Tommy Gregg	Statistics	B.S. Biology	39
Bob Wooley	Botany	B.S. Botany M.S. Entomology M.F. Forest Ecology	20
Kent Woodruff	Wildlife Biology	B.S. Wildlife Biology	25
Ed Stocks	Editor Forest Coordinator	B.S. Forestry	30
Marti Ames	Public Affairs	Not available	25

GLOSSARY OF ACRONYMS AND TERMS

A

ACRE DOSE: The weight of a product (such as a virus preparation) required in treating one acre of forest.

ADFLUVIAL: In relation to fish species, migrating between lakes and rivers or streams.

ADVERSE: Any action which is antagonistic or opposite to the preferred action.

ALTERNATIVE: One of several policies, plans, or projects proposed for decision-making.

AMENITY: An object, feature, quality, or experience that gives pleasure or is pleasing to the mind or senses. Amenity value is typically used in land use planning to describe those resource properties for which market values (or proxy values) are not or cannot be established.

ANADROMOUS FISH: Those species of fish, spawned in fresh water, which mature in the sea, and migrate back into fresh water streams to spawn. Salmon, steelhead, and shad are examples.

AQUATIC ECOSYSTEMS: Stream channels, lakes, marshes, ponds, etc. and the plant and animal communities they support.

AQUATIC HABITAT: Habitat directly related to water.

B

Bacillus thuringiensis var. kurstaki (B.t.k.): Scientific name of the active ingredient of a bacterial insecticide, which is a formulation of spores and unique crystalline bodies, produced by the bacterium. The active ingredient in biological insecticides sold under such names as Dipel®, Bactospeine®, and Thuricide®. It acts as a stomach poison to leaf eating Lepidopteran insects (moths and butterflies) as the crystal dissolves, and parallaxes the gut wall, causing the larvae to stop feeding.

BACKGROUND: The visible terrain beyond the foreground and middle ground where individual trees are not visible but are blended into the total fabric of the forest stand (see foreground and middle ground).

BENEFIT: The results of a proposed activity, program, or project expressed in monetary or non-monetary terms.

BIOLOGICAL DIVERSITY: Refers to the number of different species in the community (Kimmins 1987)

BIOPHYSICAL: The combination of biological (plants and animals) and physical (rainfall, topography) components in an ecosystem.

BOREAL: Pertaining to the northern zone of plant and animal life lying just below the tundra and usually characterized by coniferous forests. Can also refer to higher elevations near the tree line.

B.t.k.: See Bacillus thuringiensis var. kurstaki

C

CANOPY: The uppermost spreading, branch layer of a forest.

CANOPY CLOSURE: The progressive reduction of space between tree crowns as they spread laterally; a measure of potential open space occupied by the collective tree crowns in a stand.

CARBARYL: Carbamate insecticide; the active ingredient in insecticide formulations sold under the trade name Sevin®. Carbaryl expresses contact and stomach poison action on target insects and shows relatively long residual effects.

CARCINOGENICITY: Tendency of a substance to cause cancer.

CANOPY CLOSURE: The progressive reduction of space between tree crowns as they spread laterally; a measure of the percent of potential open space occupied by the collective tree crowns in a stand.

CEQ: Council on Environmental Quality.

CHRONIC HEALTH EFFECTS: Health effects that may take repeated exposures over a period of months or years before becoming apparent. Chronic health effects may blend into the general health problems of life and never be detected.

CLIMAX: Species that are self-perpetuating in the absence of a major disturbance such as fire.

CHRONIC TOXICITY: The effect of a compound on test animals when exposed to sub-lethal amounts continually. Usually, daily exposures over a period of time: weeks, months, or years.

CODE OF FEDERAL REGULATIONS (CFR...): The listing of various regulations pertaining to management and administration of the National Forests.

CONCERN: A point matter, or question raised by management or public participants that must be addressed in the planning process.

CONNECTED ACTION: Actions, which are closely related, and which: 1) Automatically trigger other actions; 2) Cannot or will not proceed unless other actions are

taken previously or simultaneously; 3) Are independent parts of a larger action and depend on the larger action for their justification.

CRITICAL HABITAT: For threatened or endangered species, the specific areas within the geographical area occupied by the species (at the time it is listed, in accordance with provisions of Section 4 of the Endangered Species Act) on which are found those physical or biological features essential to the conservation of the species. This habitat may require special management considerations or protection. Protection may also be required for additional habitat areas outside the geographical area occupied by the species at the time it is listed, based upon a determination of the Secretary of the Interior that such areas are essential for the conservation of the species.

CROWN CLASSES:

1) **Dominant -** Trees with crown extending above the general level of the crown cover and receiving full light from above and partly from the side; larger than the average trees in the stand, and with crowns well developed but possibly somewhat crowded on the sides.

2) **Co-dominant -** Trees with crowns forming the general level of the crown cover and receiving full light from above but comparatively little from the sides; usually with small crowns considerably crowded on the sides.

3) **Intermediate -** Trees shorter than those in the two preceding classes but with crowns extending into the crown cover formed by co-dominant and dominant trees; receiving little direct sunlight from above but none from the sides; usually with small crowns considerably crowded on the sides.

4) **Suppressed (Over-Topped)** - Trees with crowns entirely below the general level of the crown cover, receiving no direct light either from above or from the sides.

CUMULATIVE EFFECTS: The combined effects of two or more management activities. The effects may be related to the number of individual activities, or to the number of repeated activities on the same piece of ground. Cumulative impacts can result from individually minor but collectively significant actions taking place over a period of time.

D

DEFOLIATION: A process in which all leaves are removed from a tree. In this instance, eaten by the tussock moth.

DEIS: Draft Environmental Impact Statement.

DERMAL: Of the skin.

DEVELOPED RECREATION: Outdoor recreation requiring significant capital investment in facilities to handle a concentration of visitors on a relatively small area. Examples are ski areas, resorts, and campgrounds.

DFTM: Douglas fir tussock moth.

DIAMETER BREAST HEIGHT: (DBH) the diameter of a standing tree at a point 4 feet 6 inches from the ground.

DIPEL: Trade name of biological insecticide formulations containing the bacterium *Bacillus thuringiensis.*

DISPERSED RECREATION: Outdoor recreation in which visitors are diffused over relatively large areas. Where facilities or developments are provided, they are more for access and protection of the environment than for the comfort or convenience of the people.

DIVERSITY: The distribution and abundance of different plant and animal communities and species within the area covered by a land and resource management plan. (36 CFR 219.3).

DOUGLAS FIR TUSSOCK MOTH: a species of moth whose larvae will defoliate coniferous species of trees when populations increase to very high numbers. The typical host type for this species is Douglas fir and true firs.

DRIFT: The movement of air-borne particles from the intended contact area to other areas.

E

ECOSYSTEM: An interacting system of organisms considered together with their environment. For example: marsh, watershed, and lake ecosystems.

ECOLOGICAL DIVERSITY: The numbers and types of ecological communities contained within a specified area.

ECOLOGICAL PROCESSES: The interaction of environmental systems in promoting change in the environment.

ECOSYSTEM: An interacting system of organisms considered together with their environment; (e.g., marsh, watershed, and lake ecosystem).

EFFECTS: Environmental consequences as a result of a proposed action. Included are direct effects, which are caused by the action and occur at the same time and place; indirect effects, which are caused by the action later in time or removed in distance but are reasonably foreseeable. The term's "effects" and "impacts" as used in this statement are synonymous. Effects may be ecological (such as the effects on natural resources and on the components, structures, and functioning of affected ecosystems), aesthetic quality, historic, cultural, economic, social, or health related, whether direct, indirect, or cumulative. Effects resulting from actions may have both beneficial and detrimental aspects, even if on balance the agency believes that the overall effects will be beneficial (40 CFR 1508.8).

EIS: Environmental Impact Statement.

ENDANGERED SPECIES: Any species of animal or plant, which is in danger of extinction throughout all, or a significant portion of its range. Not included are members

of the class of insects, which have been determined by the Secretary to constitute a pest whose protection under the provisions of the Endangered Species Act would present an overwhelming, and overriding risk to humans. The appropriate Federal Agency Secretary must designate an endangered species in the Federal Register.

ENDEMIC: Restricted to and constantly present in a particular locality.

ENVIRONMENT: The aggregate of physical, biological, economic, and social factors affecting all organisms in an area.

ENVIRONMENTAL ANALYSIS: Procedure defined by the National Environmental Policy Act of 1969 whereby the environmental impacts of a planned action are objectively reviewed.

ENVIRONMENTAL ASSESSMENT: A concise public document that provides sufficient evidence and analysis for determining whether to prepare an Environmental Impact Statement or Finding of No Significant Impact. It aids in compliance with the NEPA when no Environmental Impact Statement is needed.

ENVIRONMENTAL IMPACT STATEMENT: A document prepared by a Federal Agency in which anticipated environmental effects of a planned course of action or development are evaluated.

ENVIRONMENTAL PROTECTION AGENCY (EPA): The Federal Agency with primary responsibility for enforcement of environmental regulations.

EPA: Environmental Protection Agency.

EPIDEMIC: Prevalent and spreading rapidly, widespread.

EXPOSURE: The pathways of human exposure to chemicals are dermal, oral, and inhalation.

F

FEIS: Final Environmental Impact Statement.

FLOODPLAIN: The lowland and relatively flat area adjoining inland waters, including at a minimum, that area subject to a one percent or greater chance of flooding in a given year.

FLUVIAL: Pertaining to streams or rivers, or produced by stream action; also, migrating between main rivers and tributaries.

FORAGE: Food for animals.

FORBS: Non-woody plants, other than grasses. Term refers to feed used by both wildlife and domesticated animals.

FOREGROUND: A term used in visual (scenery) management to describe the stand of trees immediately adjacent to a high-value scenic area, recreation facility, or forest highway (see background and middle ground).

FOREST CANOPY: The crown cover or upper foliage of forest trees.

FOREST LAND: Land at least occupied by forest trees of any size, or formerly having had such tree cover, and not currently developed for non-forest use.

FORMULATION: The form in which a pesticide is packaged or prepared for use.

FRY: Juvenile fish up to the time when the yoke sac has been absorbed.

FUEL LOADING: The amount of fuel present, expressed in terms of weight of fuel per unit area. This may be available fuel or (consumable fuel) total fuel and is usually dry weight.

FUELS: Combustible wildland vegetative materials. While usually applied to above ground living and dead surface vegetation, this definition also includes roots and organic soils such as peat.

G

GAME: Wildlife that are hunted for sport and regulated by state game regulations.

GUIDELINE: An indication or outline of policy or conduct that is not a mandatory requirement (as opposed to a standard, which is mandatory.

H

HABITAT: The place where a plant or animal naturally or normally lives and grows.

HALF-LIFE: The time required for half the amount of substance (such as an insecticide) in, or introduced into a living system, to be eliminated whether by excretion, metabolic decomposition, or other natural processes.

HERITAGE RESOURCES: The cultural foundation of our nation which includes the remains or records of districts, sites, areas, structures, buildings, networks, neighborhoods, memorials, objects and events from the past which have scientific, historic or cultural value. They may be historic, prehistoric, archaeological, or architectural in nature. Heritage resources are considered to be an irreplaceable and nonrenewable aspect of our national heritage.

HIDING COVER: Vegetation capable of hiding 90% of a standing deer or elk from the view of a human at a distance of 200 feet.

HORIZONTAL DIVERSITY: The distribution and abundance of plant and animal communities of successional stages across an area of land; the greater the number of communities, the higher the degree of horizontal diversity.

HOST TYPE: The preferred vegetation of the Douglas-fir tussock moth. In the case of this insect, the preferred species of tree is Douglas fir and true firs (i.e., silver fir, white fir, etc.). (Also, refer to “Percent of Host Type” in this glossary).

HYDROLOGY: The scientific study of the properties, distribution, and effects of water in the atmosphere, on the earth's surface, and in soil and rocks.

I

INDICATOR SPECIES: A wildlife management scheme in which the welfare of a selected species is presumed to indicate the welfare of other species.

INERT INGREDIENT: An ingredient found in a pesticide formulation in addition to the active ingredients, which provides a carrier medium and improves the efficacy of the active ingredient.

INHERENT: Those factors that exist in something as a permanent element.

INSECT DRIFT: Movement of dead or dying aquatic insects within a stream; an occurrence of natural mortality that can be dramatically increased with introduction of toxic substances into a stream.

INSTAR: The term for an insect before each of the molts (shedding of its skin) it must go through in order to increase in size. Upon hatching from its egg, the insect is in instar I and is so called until it molts, when it begins instar II, etc.

INTERACTIONS: Mixtures of chemicals may have substantially different toxicity than the sum of the toxicities of the components. The chemicals may interact to increase toxicity (synergism) or to decrease toxicity (antagonism).

INTERDISCIPLINARY TEAM (I.D. TEAM): A team of people that collectively represent several disciplines and whose duty it is to coordinate and integrate the planning activities.

INTEGRATED PEST MANAGEMENT (IPM): A process for selecting strategies to regulate forest pests in which all aspects of a pest-host system are studied and weighed. The information considered in selecting appropriate strategies includes the impact of the unregulated pest population on various resource values, alternative regulatory tactics and strategies, and benefit/cost estimates for these alternative strategies. Regulatory strategies are based on sound silvicultural practices and ecology of the pest-host system and consist of a combination of tactics such as timber stand improvement plus selective use of pesticides. A basic principle in the choice of strategy is that it be ecologically compatible or acceptable. (36 CFR 219.3)

INTERMITTENT STREAM: A stream that flows above ground at intervals or only flows periodically during the year. In contrast to ephemeral drainages, intermittent streams generally have well-defined channels.

INVERTEBRATE: Major group of animals, of which arthropods are members, characterized by the lack of backbone and spinal column.

IPM: See Integrated Pest Management.

IRRETRIEVABLE: Applies to losses of production, harvest, or use of renewable natural resources. For example, some or all of the timber production from an area is irretrievably lost during the time an area is used as a winter sports site. If the use is changed, timber production can be resumed. The production lost is irretrievable, but the action is not irreversible.

IRREVERSIBLE: Applies primarily to the use of nonrenewable resources, such as minerals or heritage resources, or to those factors, such as soil productivity, that are renewable only over long time periods. Irreversible also includes loss of future options.

ISSUE: A point, matter, or question of public discussion or interest to be addressed or decided through the planning process.

L

LAND ALLOCATION: The assignments of a management emphasis to particular land areas with the purpose of achieving the goals and objectives of the alternative.

LAND MANAGEMENT PLANNING: The process of organizing the development and use of lands and their resources in a manner that will best meet the needs of people over time, while maintaining flexibility for a combination or resources for the future.

LARVA (PLURAL, LARVAE): An insect in the earliest stage of development after it has hatched and before it changes into pupa, a caterpillar, maggot, or grub.

LARGE WOODY DEBRIS: Logs, tree boles, and root wads greater than 4 inches in diameter.

LATE/OLD STRUCTURE: These are timber stands that have some old growth characteristics but have not been designated as old growth in eastside land management plans.

LEPIDOPTERA: A large order of insects, including butterflies and moths, characterized by four scale-covered wings and coiled sucking mouthparts.

M

MAINTENANCE: A strategy used in the alternatives requiring relatively small doses of energy and resources to perpetuate a stable condition.

MANAGEMENT CONCERN: Any factor that is viewed as being detrimental by management.

MANAGEMENT DIRECTION: A statement that includes: multiple use and other goals and objectives, the associated management strategies, and standards and guidelines for attaining them.

MANAGEMENT INDICATOR SPECIES: See indicator species.

MANAGEMENT PRACTICE: A specific action, measure, course of action, or treatment.

MANAGEMENT STANDARDS: A unit of measure used to assess the implementation of a management practice or requirement.

MANAGEMENT STRATEGY: Management practices and intensity selected and scheduled for application on a management area to attain multiple use and other goals and objectives.

MATURE TIMBER: Trees that have attained full development, particularly in height and are in full seed production.

MEAN TREE SIZE: The mathematical average; tree size can be measured by bole diameter, bole height, or basal area.

MESIC: An area that has a balanced supply of water; neither wet nor dry. Can also refer to plants adapted to this environment.

METAPOPULATIONS: A population comprised of a set of local populations that are linked by migrants, allowing for re-colonization of unoccupied habitat patches after local extinction events.

MICRON: One millionth of a meter; a micrometer.

MICROORGANISM: A living organism so small it can be seen only with a microscope.

MIDDLEGROUND: The visible terrain beyond the foreground where individual trees are still visible but do not stand out distinctly from the stand.

MINORITY: Persons as specified in Directive 15, Office of Federal Statistical Policy and Standards, U.S. Department of Commerce, Statistical Policy Handbook (1978). Generally identified as one of the following four categories: Alaskan Native or American Indian, Asian or Pacific Islander, Black, Hispanic.

MITIGATION: Actions to avoid, minimize, reduce, eliminate, or rectify the impact of a management practice.

MODIFICATION: A visual quality objective meaning human activity may dominate the characteristic landscape but must, at the same time, utilize natural established form, line, color, and texture. It should appear as a natural occurrence when viewed in foreground or middle ground.

MONITORING: A process to collect significant data from defined sources to identify departures or deviations from expected plan outputs.

MULTI-LAYERED CANOPY: A stand of trees with two or more distinct tree layers in the canopy.

MUNICIPAL WATERSHED: One that serves a public water system as defined in Public Law 93-523 (Safe Drinking Water Act) and associated regulations. Water for human consumption is provided for at least 25 individuals for at least 60 days per year.

N

NATIONAL ENVIRONMENTAL POLICY ACT (NEPA) (1969): An "Act" to declare a national policy which will encourage productive and enjoyable harmony between humans and the environment. To promote efforts which will prevent or eliminate damage to the environment and biosphere and stimulate the health and welfare of man; to enrich the understanding of the ecological systems and natural resources important to the nation; and to establish a Council on Environmental Quality.

NATIONAL FOREST MANAGEMENT ACT (NFMA): An "Act" passed in 1976 amending the Forest and Rangeland Renewable Resources Planning Act. NFMA requires the preparation of Regional and Forest Plans and the preparation of regulations to guide that development.

NATURAL FOREST: The condition of a forest environment at any point in time including its associated plant and animal communities, which has been reached essentially through the process of natural succession. This process would include the effects of natural catastrophic occurrences.

NEPA: See National Environmental Policy Act.

NEPA PROCESS: A process, mandated by NEPA, which concentrates decision making around issues, concerns, alternatives, and the effects of alternatives on the environment.

NFMA: See National Forest Management Act.

NO ACTION: no action means any interference with natural processes by humans.

NONTARGET ORGANISMS: The organisms that inhabit the treatment area in addition to the pest species being treated. These organisms could be affected by the insecticide or treatment project.

O

OBJECTIVE: A concise, time-specified statement of measurable planned results that respond to pre-established goals. An objective forms the basis for further planning to define the precise steps to be taken and the resources to be used in achieving identified goals. (36 CFR 219.3)

OLD GROWTH: An old growth stand is defined as any stand of trees 10 acres or greater generally containing the following characteristics: 1) stands contain mature and over-mature trees in the overstory and are well into the mature growth stage; 2) stands will usually contained multi-layered canopy and trees of several age classes; 3) standing dead trees and down material are present; and 4) evidence of human activity may be present; but does not significantly alter the other characteristics and would be a subordinate factor in a description of such a stand.

ORGYIA PSEUDOTSUGATA: Scientific name for the Douglas fir tussock moth.

OVERSTORY: That portion of the trees in a forest of more than one story, forming the upper or uppermost canopy layer.

P

PACIFIC NORTHWEST REGION: Includes the states of Oregon and Washington, portions of two counties in California, and parts of three counties in Idaho. The Region (sometimes called "Region 6") contains 19 National Forests and 1 National Grassland.

PATHOGEN: Any microorganism that can cause disease.

PERCENT OF HOST TYPE: This percentage refers to the percent of a stand that is made up of trees preferred by the tussock moth. Example: If a stand of trees contain 20% Douglas-fir and 80% Ponderosa pine, then the stand is considered containing 20% host type. (Also, refer to "Host Type" in this glossary).

PERENNIAL STREAM: A stream that flows throughout the year.

PHEROMONE: Chemical produced and emitted by female moths to attract male moths for mating.

PLANT COMMUNITIES: A vegetation complex unique in its combination of plants, which occur in particular locations under particular influences. A plant community is a reflection of integrated environmental influences on the site such as soils, temperature, elevation, solar radiation, slope aspect, and rainfall.

POLICY: A guiding principle upon which a specific decision or set of decisions is based.

PM-10: Particles with an aerodynamic diameter smaller or equal to a nominal ten micrometers.

PPB: Parts per billion; the number of parts of a substance per billion parts of a given material. One ppb = 1ug/liter (water or air).

PPM: Parts per million; the number of parts of a substance in question per million parts of a given material. One ppm = 1 mg/liter (water or air).

PRACTICES: Those management activities that are proposed or expected to occur.

PRESCRIBED FIRE: A wildland fire burning under specified conditions, which will accomplish certain planned objectives. The fire may result from either planned or unplanned ignitions. The Regional Forester must approve proposals for use of unplanned ignitions for this purpose.

PRESCRIBED NATURAL FIRE: The use of unplanned natural ignitions to meet management prescriptions.

PROBABILITY: A number expressing the likelihood of occurrence of a specific event, such as the ratio of the number of experimental results that would produce the event to the total number of events considered possible.

PUBLIC ISSUE: A subject or question of widespread public interest relating to management of the National Forest System.

PUPA (PLURAL PUPAE): The immobile, transformation stage in the development of an insect that, as an adult, is completely different in its appearance compared to what it looked like when it hatched from its egg. Examples include beetles, flies, moths, and wasps.

R

RANGER DISTRICT: An administrative subdivision of the Forest, supervised by a District Ranger who reports to the Forest Supervisor.

RAPTORS: Birds of prey including hawks, eagles, falcons, and owls.

REGENERATION: The actual seedlings and saplings existing in a stand; or the act of establishing young trees naturally or artificially.

REGIONAL OFFICE: An administrative subdivision of the National Forest System, supervised by a Regional Forester who reports to the Chief of the Forest Service.

REINVASION: The movement of an organism from adjacent populations back into an area where the organism has been excluded.

RESEARCH NATURAL AREA (RNA): An area of land in as near a natural condition as possible that exemplifies typical or unique vegetation and associated biotic, soil, geologic, and aquatic features. The area is set aside to preserve a representative sample of an ecological community primarily for non-manipulative scientific and education purposes.

RESIDENT TROUT: A trout, which spends its entire life in fresh water.

RESIDUAL: Refers to remaining.

RESURGENCE: The growth of a population back to pre-treatment levels from a resident population.

RIPARIAN: Pertaining to areas of land directly influenced by water. Riparian areas usually have visible vegetation or physical characteristics reflecting this water influence. Streamside, lake borders, or marshes and wetlands are typical riparian areas.

RIPARIAN AREA: Geographically delineated areas, with distinctive resource values and characteristics that are comprised of aquatic and riparian ecosystems. Generally, on National Forests, riparian areas include lands adjacent to all streams, lakes, and ponds and areas comprising seeps, springs, and wetlands.

RIPARIAN ECOSYSTEMS: A transition between the aquatic ecosystem and the adjacent upland terrestrial ecosystem. Identified by soil characteristics and distinctive vegetation communities that require free or unbound water.

RIPARIAN VEGETATION: Vegetation growing on or near the banks of a stream or body of water on soils that exhibit some wetness characteristics during some portion of the growing season.

RISK: The degree and probability of loss based on chance.

RISK ASSESSMENT: An analytic process that is firmly based on scientific considerations, but requires judgment when available information is incomplete. These judgments inevitably draw on both scientific and policy considerations.

RNA: Refer to Research Natural Area.

RUNOFF: The flow or discharge of water from an area, including both surface and subsurface flow.

S

SAFETY FACTOR: A factor conventionally used to extrapolate human tolerances for chemical agents from "No Observed Effect Levels" in test animals.

SALMONID FISH: Fish having salmon-like characteristics- includes the trout, salmons, and whitefish.

SCENIC AREAS: Places of outstanding or matchless beauty, which require special management to preserve these qualities. They may be established under 36 CFR 294.1 whenever lands possessing outstanding or unique natural beauty warrant this classification.

SCOPING: An integral part of environmental analysis. Scoping entails: Examining a proposed action and its possible effects; establishing the depth of environmental analysis needed; and determining analysis procedures, data needs, and task assignments.

SCOPING PROCESS: Determining the extent of analysis necessary for an informed decision of a proposed action. The process includes: 1) Reviewing present management direction as it relates to the analysis; 2) Contacting interested or affected public participants by the proposed action to glean opinions or issues with the proposed action; 3) Determining local management concerns. This process continues throughout analysis until a decision is made.

SECOND GROWTH: Forest growth that has grown naturally after some drastic interference with the previous forest growth (e.g., fire, insect attack, and cutting).

SEDIMENT: Solid material, both mineral and organic, that is in suspension, and is being transported from its site of origin by air, water, gravity, or ice, or has come to rest on the earth's surface either above or below sea level.

SENSITIVE SPECIES: Those species of plants or animals that have appeared in the Federal Register as proposed for classification and are under consideration for official listing as endangered or threatened species that are on an official State list or that are recognized by the Regional Forester as needing special management to prevent their being placed on Federal or State lists.

SERAL: A biotic community, which is a developmental, transitory stage in an ecological succession.

SEVIN 4-OIL™: Commercial insecticide formulation containing the active ingredient carbaryl.

SHPO: The "State Historic Preservation Officer". The official appointed or designated pursuant to Section 101(b)(1) of the National Historic Preservation Act to a00000dminister the State historic preservation program or a representative designated to act for the SHPO. Among other duties, the State Historic Preservation Officer advises and assists Federal agencies and State and local governments and cooperates with these agencies and others to ensure that historic properties are considered at all levels of planning and development.

SNAG: A standing dead tree.

SPREADER/STICKER AGENT: Substances that improve the performance of the pesticide. They are added to the spray tank, separate from the pesticide formulation. Spreader causes the formulation to spread out more to increase coverage; sticker increases the adhesion or "stickiness" of the pesticide.

SERAL STAGE: An identifiable step in succession.

STAND: Timber possessing uniformity as regards to type, age class, risk class, vigor, size class, and stocking class.

STANDARD: A principle requiring a specific level of attainment, a rule to measure against.

STRUCTURAL DIVERSITY: Diversity in a forest stand that results from layering or tiering of the canopy; an increase in layering or tiering leads to an increase in structural diversity (Thomas 1979), (Brown 1985).

STRUCTURE: The configuration of elements, parts, or constituents of a habitat, plant or animal community of forest stands (adapted from Thomas 1979). (Brown 1985)

SUCCESSION: A sequence of vegetative change that proceeds following a disturbance.

SUPPRESSED TREES: Trees in a forest stand whose crowns are below the general level of the canopy; growth is inhibited due to competition for a limited resource such as sunlight; such trees are weak, slow growing, and often die.

T

THERMAL COVER: Vegetation that provides wildlife shelter from climatic conditions.

THREATENED SPECIES: Any species listed in the Federal Register, which is likely to become an endangered species within the foreseeable future throughout all or a significant portion of its range.

THRESHOLD: This is the point on a dose-response curve, above, which effects occur and below which no effects occur.

TIERING: Refers to the coverage of general matters in broader environmental impact statements (such as National program or policy statements) with subsequent narrower statements or environmental analysis (such as regional or basin-wide program statements or, ultimately, site-specific statements) incorporating by reference the general discussions and concentrating solely on the issues specific to the statement subsequently prepared.

TOLERANCE: Forestry term for expressing the relative capacity of a tree to compete under low light and high root competition.

TOLERANT SPECIES: Plants that grow well in shade.

TOXIC: Relating to a harmful effect by a poisonous substance on the human body by physical contact, ingestion, or inhalation.

TOXICANT: A poison; toxic agent.

TOXICOLOGY: The study of the nature and detection of poisons and the treatment of poisoning.

TRUE FIR: Those species of trees such as white, silver, and grand fir located on high-elevation soil sites. A specific ecological plant community.

U

UNCERTAINTY: May be due to missing information, or gaps in scientific theory. Whenever uncertainty is encountered, a decision, based upon scientific knowledge and policy considerations must be made. The term, scientific judgment, is used to distinguish this decision from policy decisions made in risk management.

UNDERBURN: Process where fire, either natural or prescribed, burns hot enough so that vegetation under a stand of timber is either killed and/or consumed yet the fire is not hot enough to kill the trees in the overstory.

UNDERSTORY: Vegetation growing under a higher canopy.

USDA: United States Department of Agriculture.

USDI: United States Department of the Interior.

V

VERTEBRATES: Those organisms having a spinal column protected by bone or cartilage.

VERTICAL STRUCTURE: Recognizable layers of vegetation, including overstory, understory, shrub and herb layers.

VIEWSHED: The total landscape seen, or potentially seen, from all or a logical part of a travel route, use area, or water body.

VISIBILITY: How far the human eye can see a given object. The greatest distance in a given direction at which it is just possible to see and identify with the unaided eye in the daytime, a prominent dark object and, at night, a known, preferably unfocused, moderately intense light source.

VISUAL QUALITY OBJECTIVE: A combination of inherent scenic quality and public interest that defines the acceptable degree of alteration for and given area.

VISUAL RESOURCE (FOREST SCENERY): The composite of basic terrain, geologic features, water features, vegetative patterns, and land use effects that typify a land unit and influence the visual appeal the unit may have for visitors. Visual resource categories include Retention, Partial Retention, and Modification.

W

WATER QUALITY: The biological, physical, and chemical properties of water that make it suitable for given specified uses. Definition of water quality for forest areas is difficult because of the wide range of downstream uses.

WATERSHED: The line separating head-streams which flow to different river systems, it may be sharply defined (crest of a ridge), or indeterminate (in a low undulating area).

WESTERN SPRUCE BUDWORM: (*Choristoneura occidentalis*) a member of the Lepidoptera family that defoliates and damages the cones of several species of conifers. (Forest Insect and Disease Leaflet 53).

WETLANDS: Those areas that are inundated by surface or ground water with a frequency sufficient to support, and under normal circumstances do or would support, a prevalence of vegetation or aquatic life. These organisms require saturated or seasonally saturated soil conditions for growth and reproduction. Wetlands generally include swamps, marshes, bogs, and similar areas such as sloughs, potholes, wet meadows, river overflows, mud flats, and natural ponds.

WILD AND SCENIC RIVERS: Those rivers or sections of rivers designated as such by congressional action under the 1968 Wild and Scenic Rivers Act, as supplemented and amended, or those sections of rivers designated as wild, scenic, or recreational by an act of the Legislature of the state or states through which they flow.

WILDERNESS: Areas designated by congressional action under the 1964 Wilderness Act. Wilderness is defined as undeveloped Federal land retaining its primeval character and influence without permanent improvements or human habitation. Wilderness areas are protected and managed to preserve their natural conditions, which generally appear to have been affected primarily by the forces of nature, with the imprint of human activity substantially unnoticeable, have outstanding opportunities for solitude, or for a primitive and unconfined type of recreation; include at least 5,000 acres or are of sufficient size to make practical their preservation, enjoyment, and use in an unimpaired condition; and may contain features

of scientific, educational, scenic, or historical value as well as ecological and geologic interest.

WILDFIRE: Any wildland fire that requires a suppression response.

WINTER RANGE: The area available to and used by big game through the winter season

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